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ON TWO-DIMENSIONAL TEMPERATURE MODELING\*

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## PREFACE

This paper is intended to provide the theoretical and practical framework for a two-dimensional temperature model. The motivation for this study is provided by the existence, at Rand, of a general two-dimensional flow-reaction simulation model developed by J. Leendertse and E. Gritton. The vertically integrated mass balance equations of the simulation model are discussed and shown to apply to temperature modeling. Terms contributing to the total heat flux across the water surface are described and approximated by empirical relations which, in turn, are integrated into the temperature model through an equilibrium temperature and heat exchange coefficient. The sensitivity of these parameters to the meteorological variables is discussed in the context of a preliminary calculation. Tables are given for the heat exchange coefficient and equilibrium temperature. Finally, expressions are derived for the relative isobaric slope as a function of chlorinity and temperature.

Although this paper is primarily a review, the approach of Edinger and Geyer is modified for the case when data is averaged over periods of less than a day. The following advantages of the E-G approach appear to remain:

- (1) Additional arrays to compute the surface heat exchange at each grid point are not required (although it may be necessary to divide the bay into large sub-regions with different  $T_{eq}$  and  $K$ ).
- (2) The method is readily adaptable to long term calculations.

Sections 3 and 4 of this report (on computation of absorbed radiation) were included to emphasize the need for further research. The empirical formulations discussed are essentially useless in the development of a temperature model, but improved versions of these equations could be quite valuable in tapping the model's predictive capacities.

CONTENTS

Preface . . . . .	iii
Section	
I. The Heat Transfer Equation . . . . .	1
II. Heat Exchange Coefficients and Equilibrium Temperature . . . . .	3
III. Net Isolation . . . . .	8
IV. Long-Wave Radiation . . . . .	12
V. Evaporation . . . . .	14
VI. Convective Heat Exchange . . . . .	16
VII. Preliminary Calculations . . . . .	17
Appendix	
A. Temperature Dependence of Relative Isobaric Slopes . . . . .	45
B. Modified Dewpoint Temperature . . . . .	50
References . . . . .	52

# I. THE HEAT TRANSFER EQUATION

It is desired to exploit as far as possible the similarity between the heat and mass transfer equations. The former may be written:

$$\begin{aligned} \frac{\partial T}{\partial t} + \frac{\partial}{\partial x} (uT) + \frac{\partial}{\partial y} (vT) + \frac{\partial}{\partial z} (wT) &= \frac{\partial}{\partial x} \left( K_x \frac{\partial T}{\partial x} \right) \\ + \frac{\partial}{\partial y} \left( K_y \frac{\partial T}{\partial y} \right) + \frac{\partial}{\partial z} \left( K_z \frac{\partial T}{\partial z} \right) + \frac{S_Q}{\rho C_p} \end{aligned} \quad (1.1)$$

where  $\rho$  = density of water, assumed constant at  $62.4 \text{ lb-ft}^{-3}$ ,  
 $K_x, K_y, K_z$  = thermal eddy diffusivity,  $C_p$  = specific heat of water taken as  $4.1 \text{ Joule-g}^{-1} \text{ } ^\circ\text{C}^{-1} = .98 \text{ Btu-lb}^{-1} \text{ } ^\circ\text{F}^{-1}$  (assumed constant although it may vary as much as 1% due to salinity and temperature distributions in the bays under consideration, and far more in some estuaries),  $S_Q$  = local heat source and sink.

Next, introduce the following distributions and vertically averaged variables:

$$\bar{T} = \frac{1}{H} \int_{-h}^{\zeta} T dz = \frac{1}{H} \langle T \rangle \quad (1.2)$$

$$T(z) = \bar{T} [1 + \epsilon_T(z)] \quad (1.3)$$

$$u = U [1 + \epsilon_u(z)] \quad \text{etc.} \quad (1.4)$$

The exact vertically integrated continuity equation is <sup>(1)</sup>

$$\begin{aligned} \frac{\partial \zeta}{\partial t} + \vec{\nabla} \cdot \langle \vec{V} \rangle &= 0 \quad \text{where } \vec{V} = (u, v) \text{ and } \vec{\nabla} = \\ &\left( \frac{\partial}{\partial x}, \frac{\partial}{\partial y} \right) \end{aligned} \quad (1.5)$$

and the boundary conditions on the free surface and on the bottom are

$$w_{\zeta} = \frac{\partial \zeta}{\partial t} + \vec{\nabla} \cdot \vec{V}_{\zeta} \quad , \quad w_{-h} = -\frac{\partial h}{\partial t} - \vec{\nabla}_{-h} \cdot \vec{V}_{-h} \quad (1.6)$$

Vertically integrating (1.1) and substituting equations (1.5 - 1.6), we obtain

$$\begin{aligned} & Q_T / \rho C_p + \left\langle \frac{\partial}{\partial x} \left( K_x \frac{\partial T}{\partial x} \right) \right\rangle + \left\langle \frac{\partial}{\partial y} \left( K_y \frac{\partial T}{\partial y} \right) \right\rangle + \left\langle \frac{\partial}{\partial z} \left( K_z \frac{\partial T}{\partial z} \right) \right\rangle \\ & = \left[ \frac{\partial}{\partial t} \langle T \rangle - T_\zeta \frac{\partial \zeta}{\partial t} - T_{-h} \frac{\partial h}{\partial t} \right] + \left[ \vec{v} \cdot \langle \vec{v} T \rangle - T_\zeta \vec{v}_\zeta \cdot \vec{v}_\zeta - T_{-h} \vec{v}_{-h} \cdot \vec{v}_{-h} \right] \\ & + [v_\zeta T_\zeta - w_{-h} T_{-h}] = \frac{\partial}{\partial t} \langle T \rangle + \vec{v} \cdot \langle \vec{v} T \rangle \end{aligned} \quad (1.7)$$

Here,  $Q_T$  is the net heat flux into the vertical water column through the surface and bottom. In terms of the quantities  $\alpha_{uT}$ , and  $\alpha_{vT}$  first introduced by Leendertse, where<sup>(2)</sup>

$$\alpha_{uT} = \frac{1}{H} \langle 1 + \epsilon_u(z) \epsilon_T(z) \rangle, \text{ etc. }, \quad (1.8)$$

the right hand side becomes

$$\text{RHS} = \frac{\partial}{\partial t} (H \bar{T}) + \frac{\partial}{\partial x} (H \alpha_{uT} \bar{T} U) + \frac{\partial}{\partial y} (H \alpha_{vT} \bar{T} V) \quad (1.9)$$

If  $T$  is uniformly distributed over the vertical, then  $\alpha = 1$ . This assumption is adopted throughout this paper, but the general equation may be the subject of future investigations. The vertically integrated diffusion terms are discussed by Leendertse for the case of the mass balance equation. The same analysis is assumed to apply here.

## II. HEAT EXCHANGE COEFFICIENTS AND EQUILIBRIUM TEMPERATURE

The Leendertse-Gritton general mass-balance model for n reacting constituents is described by the matrix equation

$$\begin{aligned} \frac{\partial (\overline{HP})}{\partial z} + \frac{\partial (\overline{HUP})}{\partial x} + \frac{\partial (\overline{HVP})}{\partial y} - \frac{\partial}{\partial x} (\overline{HD}_x \frac{\partial \overline{P}}{\partial x}) \\ - \frac{\partial}{\partial y} (\overline{HD}_y \frac{\partial \overline{P}}{\partial y}) + [\mathbf{K}] \overline{HP} + \overline{HS} = 0 \end{aligned} \quad (2.1)$$

where  $[\mathbf{K}]$  = reaction matrix, and  $\overline{S}$  = source or sink vector.

For DO-BOD reactions, the K-matrix and  $\overline{S}$  are written in the form

$$[\mathbf{K}] = \begin{bmatrix} K_{11}/H & 0 \\ K_{21} & K_{22} \end{bmatrix} \quad (2.2)$$

$$\overline{S} = \begin{pmatrix} -K_{11} C_{sat}/H \\ 0 \end{pmatrix} \quad (2.3)$$

This suggests an analogy with the linear heat exchange model of Edinger and Geyer, where  $K/\rho C_p$  replaces  $K_{11}$  and the equilibrium temperature replaces  $C_{sat}$ . Here  $K$  is the heat exchange coefficient. (4-7)  $K_{21}$  has no counterpart in the E-G model but can be utilized to describe the temperature dependence of processes such as reaeration. For computational and theoretical convenience, therefore, we shall employ the following expression for heat transported across the surface:

$$Q_T = (T_{eq} - T)K \quad (2.4)$$

The remainder of this section will be devoted to deriving expressions for  $K$  and  $T_{eq}$  in terms of meteorological variables.

The energy budget equation is

$$Q_T = (Q_{net} + Q_{anet}) - (Q_{br} + Q_c + Q_e) \quad (2.5)$$

where

$Q_{\text{net}}$  = net solar radiation

$Q_{\text{anet}}$  = atmospheric radiation

$Q_{\text{br}}$  = long-wave back radiation

$Q_c$  = convection heat exchange

$Q_e$  = rate of heat transport due to evaporation

The details of the energy budget terms will be discussed in later sections. Our concern here is with the dependence on water surface temperature. In particular, while  $(Q_{\text{net}} + Q_{\text{anet}})$  is independent of  $T_s$ , the other terms may be written as follows:

$$\begin{aligned} Q_{\text{br}} &= D (T_0 + T_s)^4 \\ Q_e &= \rho (L_0 - L_1 T_s) (e_s - e_a) f \\ Q_c &= \rho B (L_0 - L_1 T_s) (T_s - T_a) f \end{aligned} \quad (2.6)$$

where  $e_s$ ,  $e_a$  are the saturation vapor pressure at  $T_s$  and the ambient vapor pressure in inches Hg, respectively;

$\rho$  = water density,  $D = .1661 \times 10^{-8} \text{ Btu hr}^{-1} \text{ ft}^{-2} \text{ }^\circ\text{R}^{-4}$

$T_0 = 460^\circ\text{F}$

$L_0 = 1093.2 \text{ Btu/lb.}$

$L_1 = .57 \text{ Btu/lb.}^\circ\text{F},$

and  $f$ ,  $B$  are meteorological variables.

Whereas (2.4) implies that, without advection,  $T$  instantaneously decays toward  $T_{\text{eq}}$  with decay time  $C_p/H/K$ , it is clear from (2.6) that considerable complexities are buried in  $K$  and  $T_{\text{eq}}$ . Specifically,  $K$  is not independent of  $T_s$ , and  $T_{\text{eq}}$  is the solution of a transcendental equation.

Furthermore,  $T_s$  appears in (2.6) rather than the vertically averaged temperature,  $T$ . Even in supposedly well-mixed cases, it may not be a good approximation to replace  $T_s$  with  $T$ . Measurements of the vertical temperature distribution may be needed to settle this question (and the related matter of determining  $\alpha_{uT}$  and  $\alpha_{vt}$ ).<sup>(6)</sup>

Substituting equations (2.6) into (2.4) we obtain

$$\begin{aligned} Q_T &= (Q_{\text{net}} + Q_{\text{anet}}) - D (T_0 + T_s)^4 \\ &- \rho (L_0 - L_1 T_s) (e_s - e_a) f - \rho B (L_0 - L_1 T_s) (T_s - T_a) f \\ &= K (T_{\text{eq}} - T) \end{aligned} \quad (2.7)$$

We shall assume that  $T_s = T$ . Then  $T_{\text{eq}}$  is defined by the equation

$$\begin{aligned} &(Q_{\text{net}} + Q_{\text{anet}}) - D (T_0 + T_{\text{eq}})^4 \\ &- (L_0 - L_1 T_{\text{eq}}) \left[ (e_{\text{eq}} - e_a) + B(T_{\text{eq}} - T_a) \right] \rho f \\ &= G(T_{\text{eq}}) = 0 \end{aligned} \quad (2.8)$$

which says that  $T_{\text{eq}}$  is the surface temperature (= vertically averaged temperature) at which the heat transported across the surface is zero.

Edinger and Geyer do not solve (2.8) directly. Rather, they first linearize the back scattering term and then assume the relation  $(e_{\text{eq}} - e_a) / (T_{\text{eq}} - T_d) = (e_s - e_a) / (T_s - T_d)$ . The latter relation is not a bad approximation if temperatures are averaged over a day or more, so that  $T_{\text{eq}}$  and  $T_s$  are nearly equal. For our purposes, it is a very poor approximation which introduces an unwanted  $T_s$  dependence into  $T_{\text{eq}}$ , and thereby necessitates computation of  $T_{\text{eq}}$  at each grid point. Our approach is to find  $T_{\text{eq}}$  numerically by Newton's method. This is quite effective since  $G(T_{\text{eq}})$  is a monotonically decreasing function which can be expressed analytically if the saturation vapor pressure at  $T_{\text{eq}}$  is evaluated with the Lamoreaux exponential approximation. One may obtain the initial value of  $T_{\text{eq}}$  for the iteration from the previous time step. The Lamoreaux approximation is given by<sup>(8)</sup>

$$e(T) = 6.4129 \times 10^6 \exp \left( - \frac{7482.6}{398.362 + T} \right) \quad (2.9)$$

which, when combined with equation (2.8), yields the iteration formula:

$$T_{cq}' = T_{eq} - G(T_{eq})/G'(T_{eq}) \quad (2.10a)$$

where  $G(T_{eq})$  is given by equation (2.8) and

$$\begin{aligned} G'(T_{eq}) = & -4D(T_0 + T_{eq})^3 + L_1 \rho f \left[ (e_{eq} - e_a) + B(T_{eq} - T_a) \right] \\ & - f \rho (L_0 - L_1 T_{eq}) \left\{ B + e_{eq} \left\{ \frac{7482.6}{(398.362 + T_{eq})^2} \right\} \right\} \end{aligned} \quad (2.10b)$$

The procedure outlined above is quite efficient. If the equilibrium temperature is computed hourly so that it changes only a couple of degrees at each time step, no more than two iterations are required to update  $T_{eq}$ .

Since the equilibrium temperature will characteristically pass through the water temperature,  $T$ , twice daily on its roughly sinusoidal path, it is evident that equation (2.7) is not well suited for direct calculation of  $K$  (i.e. the coefficient of  $K$  might be zero).

Alternatively, one may subtract (2.8) from (2.7) setting  $L_0 - L_1 T_s = \text{constant} = 1050$ , to obtain:

$$\begin{aligned} D \left[ (T_0 + T_{eq})^4 - (T_0 + T)^4 \right] + 1050 \rho f \left[ (e_{eq} - e) + B(T_{eq} - T) \right] \\ = K(T_{eq} - T) = K \left[ (T_{eq} + T_0) - (T_0 + T) \right] \end{aligned} \quad (2.11)$$

or,

$$\begin{aligned} K = D \left[ (T_0 + T_{eq})^3 + (T_0 + T_{eq})^2 (T_0 + T) + (T_0 + T_{eq}) \cdot \right. \\ \left. (T_0 + T)^2 + (T_0 + T)^3 \right] + 1050 \rho f \left\{ B + \left[ (e_{eq} - e_T) / \right. \right. \\ \left. \left. (T_{eq} - T) \right] \right\} \end{aligned} \quad (2.12)$$

The term  $(e_{eq} - e_T) / (T_{eq} - T)$  may cause trouble when  $(T_{eq} - T)$  is near zero, but for  $|T_{eq} - T| < 10^\circ\text{F}$  it will be sufficiently accurate to use the relation

$$(e_{eq} - e_T) / (T_{eq} - T) \approx \frac{\partial e}{\partial T} \left( \frac{T + T_{eq}}{2} \right) = \left[ \frac{173.004}{796.724 + T + T_{eq}} \right]^2 e \left( \frac{T + T_{eq}}{2} \right) \quad (2.13)$$

Since K depends on T, it would seem necessary to calculate it at each grid point. In section VII we see that K is not very sensitive to T, so that usually one value of K will suffice for the whole bay.

The linear approximation to equation (2.11) devised by Edinger and Geyer amounts to replacing the first bracket by  $4\pi T_0^3$ , and the factor  $(e_{eq} - e_T) / (T_{eq} - T)$  by  $(e_s - e_a) / (T_s - T_d)$ . Neither assumption is very good for T averaged over less than a day.

If our working hypothesis, that  $T=T_s$ , turns out to be untenable we need merely replace T by  $T_s$  in (2.7), (2.11-2.12), and employ measured values of  $T_s$ . It may also be possible to set  $T_s = T[1+\epsilon_T(z)]$ , where  $\epsilon_T(z)$  is the vertical temperature distribution.

Before describing the general features of  $T_{eq}$  and K, including sensitivities to fluctuations in the various terms of the energy budget, the next few sections will be devoted to calculating contributions to the total surface heat transport.

We note in passing that an alternative scheme to that of Edinger and Geyer would be to use equation (2.7) for the heat flux  $Q_T$  and insert it directly into equation (1.7). This would require computation of  $Q_T$  at each grid point. The evaluation of K and  $T_{eq}$  is more complex than that of  $Q_T$ , but the former does not require new spatial arrays. A further advantage of the E-G scheme is that average values of K and  $T_{eq}$  obtained from short term representative periods (e.g. tidal cycle) can be used in long term calculations since these values characterize the entire waterbody, whereas  $Q_T$  is a local variable. In addition,  $T_{eq}$  possesses natural periodicity which is amenable to Fourier representation. (4)

### III. NET INSOLATION

The solar radiation on a horizontal surface at sea level is primarily a function of solar altitude, cloud cover and cloud height. The solar altitude can be obtained from the date, the hour and the latitude. In particular, we have

$$\sin \alpha = \sin \phi \sin \delta + \cos \delta \cos \phi \cos \beta \quad (3.1)$$

where  $\phi$  = latitude,  $\delta$  = solar declination, and  $\beta$  = local hour angle (LHA). The local hour angle is given in radians by

$$\begin{aligned} \beta &= \frac{\pi}{180} (\text{Greenwich hour angle} - \text{longitude}) \\ &= \frac{\pi}{12} (\text{Local standard time} + \text{No. Time Zones to Greenwich} \\ &\quad - \text{longitude}/15 - \Delta - 12) \end{aligned} \quad (3.2)$$

Approximate values for  $\Delta$  and  $\delta$  are tabulated in Table 1. <sup>(9,10)</sup>

The total incident solar radiation may be obtained from the following empirical formula based on Raphael's curves: <sup>(11)</sup>

$$Q_s = 329 \sin \left| \left[ 1.05076 \alpha - 5.049 + \omega (15 - \alpha)^2 \right] \right| ,$$

when  $\sin \alpha > 0$ ;

$Q_s = 0$ , when  $\sin \alpha \leq 0$ ;

$\omega = 0$ , when  $\sin \alpha \geq 0.26$ ;

$\omega = .02244$ , when  $0 < \sin \alpha < 0.26$  . (3.3)

$Q_s$  as given by (3.3) gives sufficiently accurate values for clear skies. For cloudy skies these values must be modified by an appropriate factor. The cloud factor given by Raphael and based on the work of Fritz is  $(1 - .0071 C^2)$ , where  $C$  is expressed in tenths of sky covered. Comparison with available data reveals that this factor, when combined with  $Q_s$  above, produces accurate results for mean monthly solar radiation. The negative bias observed by Anderson for Mosby's factor does not appear here. However, as pointed out

Table 1

<u>Date</u>	<u><math>\Delta</math></u> (min)	<u><math>\delta</math></u> (deg)
Jan 1	+ 3	-23.06
11	+ 8	-21.90
21	+11	-20.04
Feb 1	+14	-17.28
11	+14	-14.23
21	+14	-10.78
Mar 1	+13	- 7.83
11	+10	- 3.96
21	+ 8	- .01
Apr 1	+ 4	+ 4.30
11	+ 1	+ 8.08
21	- 1	+11.64
May 1	- 3	+14.88
11	- 4	+17.72
21	- 4	+20.06
Jun 1	- 2	+21.97
11	- 1	+23.04
21	+ 1	+23.44
Jul 1	+ 4	+23.16
11	+ 5	+22.20
21	+ 6	+20.60
Aug 1	+ 6	+18.19
11	+ 5	+15.47
21	+ 3	+12.33
Sep 1	0	+ 8.52
11	- 1	+ 4.80
21	- 7	+ .96
Oct 1	-10	- 2.94
11	-13	- 6.78
21	-15	-10.47
Nov 1	-16	-14.23
11	-16	-17.25
21	-14	-19.78
Dec 1	-11	-21.71
11	- 7	-22.95
21	- 2	-23.29

by Anderson, large deviations may occur for daily solar radiation unless this factor is further refined to include variations due to cloud height. It is essential to accumulate an extensive record comprising hourly pyranometer measurements and cloud cover and cloud height readings. Although many workers would prefer to utilize field data rather than to concern themselves with the intricacies of cloud attenuation, the latter option may lead to greater flexibility and predictive capability due to the existence of long term meteorological records suitable for statistical analysis. The following empirical formula for insolation on a cloudy day should be regarded as tentative:

$$Q_i = (1 - 0.0071 C^2) Q_s \quad (3.4)$$

The reflectivity of the water surface,  $R$ , is defined by

$$R = Q_{\text{refl.}} / Q_i \quad (3.5a)$$

and

$$Q_{\text{net}} = Q_i (1 - R) \quad (3.5b)$$

where  $Q_{\text{net}}$  is the net solar radiation entering the water after reflection at the surface.  $R$  is principally a function of solar altitude, type and amount of cloudiness, and atmospheric turbidity. Turbidity has been shown to be relatively unimportant except in notably extreme cases. Anderson has given the following general empirical formula for reflectivity:

$$R = a\alpha^b, \quad (3.6)$$

where  $\alpha$  is solar altitude, as before, and  $a$  and  $b$  are experimentally determined parameters related to the amount and height of clouds. If the cloud dependency of  $a$  and  $b$  is ignored, errors of order 5% or less are incurred in the total daily  $Q_i$ . To avoid accumulation of error in computations for periods of a week or longer, the following empirical formula, based on Anderson's curves, may be used:

$$-b = 1.1073 \log_{10}(N/D) \quad (3.7a)$$

$$a = 1/2 (N/10^b + D/10^{1.9031b}) \quad (3.7b)$$

where

$$N = (.2004 F_c + .2341 F_s + .2006 F_b + .1172 F_o) \quad (3.7c)$$

$$D = (.04040 F_c + .03115 F_s + .04877 F_b + .04694 F_o) \quad (3.7d)$$

and  $F_c$ ,  $F_s$ ,  $F_b$ ,  $F_o$  are the frequencies respectively for clear skies ( $C=0$ ), scattered clouds ( $C=1-5$ ), broken clouds ( $C=6-9$ ), and overcast ( $C=10$ ). To avoid infinite reflectivities, set  $R$  equal to its value at  $5^\circ$  when  $0 \leq \alpha \leq 5^\circ$ .

In summary, the net solar radiation entering the water after reflection at the surface is given by equation (3.4-3.6), i.e.

$$Q_{net} = (1 - 0.0071 C^2) (1 - a\alpha^b) Q_s \quad (3.8)$$

where  $a$  and  $b$  are given by equation (3.7) and  $Q_s$  by equation (3.3)

#### IV. LONG-WAVE RADIATION

Two ways for obtaining the net atmospheric radiation will be discussed. One is direct measurement. The other is through an empirical formulation promulgated by Anderson.<sup>(12)</sup>

Atmospheric radiation can be measured by subtracting pyranometer (shortwave) readings from pyradiometer (long and short wave) readings. As pointed out below, good measurements are prudent before acceptance of any empirical scheme.

Not all factors determining the atmospheric radiation are known or quantitatively understood. The primary ones, undoubtedly, are the total moisture content of the atmosphere and the temperature of the constituent water vapor. Any attempt to by-pass these factors by using local vapor pressures and ambient temperatures is doomed to partial failure. In particular, Anderson's study revealed that a 5% to 10% error is inherent in such efforts.

Anderson assumes that the atmosphere acts like a "gray body" of variable "grayness", obeying a modified Stefan-Boltzmann law:

$$Q_a = \beta \sigma (T_0 + T_a)^4 \quad (4.1)$$

where  $\sigma$  = Stefan-Boltzmann constant =  $.1712 \times 10^{-8} \text{ Btu hr}^{-1} \text{ ft}^2 \text{ R}^{-4}$

and  $\beta$  = atmospheric moisture factor =  $a + b e_a$ . (4.2)

The parameters  $a$  and  $b$  are given by the following formulas:

$$a = .740 + .025 C \exp(-.0584h) \quad (4.3a)$$

$$b = .164 - .018 C \exp(-.060h) \quad (4.3b)$$

where  $C$  is the cloud cover in tenths of sky covered, and  $h$  is the cloud height in thousands of feet ( $1.6 < h < \infty$ ).

The partial success of Anderson's approach hinges on the approximate correlation between local vapor pressure and total moisture content of the atmosphere. Unfortunately, any parameter fit reflecting this relationship must be restricted to use in locations which have similar air mass characteristics. Failure to determine parameters locally may, therefore, introduce bias of unpredictable

magnitude, in addition to the random error of order 10% already present.

In summary, Anderson's equations (4.1 - 4.2) may be used with reasonable accuracy provided they are calibrated by adjusting the numerical constants in a and b for each new location.

The long-wave radiation reflected from the water surface is approximately 3% of the impinging atmospheric radiation for the normal range of water temperatures. Therefore we may write

$$Q_{\text{anet}} = 0.97 Q_a \quad . \quad (4.4)$$

The water body itself radiates like a gray body of emissivity 0.97 provided no film (e.g. oil slick) is present. This value is essentially independent of salinity. Therefore,

$$Q_{\text{br}} = 0.97 \sigma (T_0 + T_s)^4 \quad (4.5)$$

so that  $D = (.97) (.1712 \times 10^{-8}) = .1661 \times 10^{-8} \text{ Btu hr}^{-1} \text{ ft}^{-2} \text{ } ^\circ\text{R}^{-4}$ .

# V. EVAPORATION

The results of evaporation studies to date are not conclusive.<sup>(1,12-14)</sup> Anderson's exhaustive Lake Hefner investigation produced an empirical equation of the form

$$Q_e = (L_o - L_1 T_s) (e_s - e_a) \rho f \quad \text{Btu ft}^{-2} \text{ hr}^{-1} \quad (5.1)$$

where

$$f = M W \quad \text{ft hr}^{-1} \text{ in-Hg}^{-1} \quad (5.2)$$

and  $W$  = wind speed (m.p.h.) at a specified height,  $H_w$ , above the water surface;  $M$  = empirical constant;  $e_s$  = saturation vapor pressure (in-Hg) at the water surface temperature; and  $e_a$  = ambient vapor pressure of unmodified air (i.e. unmodified by passage over the waterbody).

Using equation (2.9),  $e_s$  is given by

$$e_s = e(T_s) \quad (5.3)$$

while  $e_a$  is obtained either from

$$e_a = e(T_d) \quad (5.4)$$

where  $T_d$  is the dew point, or from

$$e_a = e(T_{wb}) - P(T_a - T_{wb}) (3.59 \times 10^{-4} + 2.34 \times 10^{-7} T_{wb}) \quad (5.5)$$

where  $T_{wb}$  = wet bulb temperature,  $T_a$  = air temperature or dry bulb temperature, and  $P$  = atmospheric pressure in-Hg.

Anderson found that  $M = 2.08 \times 10^{-4} \text{ ft hr}^{-1} \text{ in-Hg}^{-1}$ . In addition, the Lake Hefner work appeared to support the theoretical efforts<sup>(15,16)</sup> of Sverdrup and Sutton. Later studies contradicted these theories, however, and there presently exists no reliable formula derived from either continuous or discontinuous mixing concepts. All that has survived the series of investigations conducted by the USCS is an empirical correlation between  $M$  and the size of the waterbody for the case when  $H_w = 2$  meters:<sup>(13)</sup>

$$M = \frac{.000397}{A} \text{ ft hr}^{-1} \text{ in Hg}^{-1} \quad (5.6)$$

[Note: to convert M in  $(\text{in day}^{-1} \text{ m}_b^{-1})$  to M in  $(\text{ft hr}^{-1} \text{ in-Hg}^{-1})$  multiply by .11759.] Here, A is the area of the waterbody in acres. The standard error of (5.6) is given as 16%.

The reasons for the above correlation are clear in a qualitative sense. First, there is a downwind decrease in evaporation rates. Generally, this will decrease M for increasing area, and, in addition, introduce a fetch dependence into M.

Secondly, the wind profiles depend on the size of the waterbody. With increasing fetch, the wind shear resulting from surface drag decreases. For example, if the wind speed at 8 meters were the same for a large and small lake, then at 2 meters the wind speed over the large lake would be greater. As a result, if one wishes to use wind measurements made near the water surface (e.g. at 2 meters) one must compensate by using a smaller M for larger water surface areas.

Since (5.6) gives only a fair approximation to these effects even for regularly shaped lakes, this equation should be applied to geometrically complex estuaries with some trepidation. It is quite likely that for Tampa Bay evaporation rates depend in a complicated fashion on location in the bay and on wind direction, as well as on wind speed.

Two final points should be made regarding the use of equation (5.6). This equation applies only if the anemometer readings are taken in mid-bay. Also, it applies only to measurements at 2 meters, a height chosen to minimize the effects of atmospheric instability. If some measurements are made at different heights, the wind speed input must be adjusted accordingly. For example, the wind speed at 4 meters is approximately 6% greater than at 2 meters for a 50,000 acre bay. If a wide range of heights are used, detailed knowledge of the wind profile may be required to obtain the appropriate correction factors.

## VI. CONVECTIVE HEAT EXCHANGE

There is no easy way to measure the convective heat transport nor any reliable way to calculate it. Consequently, one must rely, however reluctantly, on a 45-year-old prescription due to Bowen:<sup>(12,17,18)</sup>

$$Q_c = B(T_a - T_s) / (e_a - e_s) Q_e \quad (6.1)$$

where

$$B = 3.39 \times 10^{-4} P \text{ in. Hg. } ^\circ\text{F}^{-1} \quad (6.2)$$

and  $P$  = atmospheric pressure in inches Hg.

The physical content of (6.1) is essentially that the evaporation eddy diffusivity and the eddy conductivity are equal.

Generally, one can ignore conduction in comparison with convection in much the same fashion as one ignores the contribution of molecular diffusion to evaporation (perhaps unless a strong thermal gradient increases free convection to a significant degree). One further assumes that the effects of spray on evaporation and the effects of radiative transfer (in moist air above the water) on conduction are negligible.

The equality of eddy coefficients has been questioned for some time and several researchers have modified the Bowen constant in instances where unstable atmospheric conditions prevail. The magnitude of deviation is thoroughly speculative, however, especially for large lapse rates associated with high temperature outfalls.<sup>(5)</sup> Even the careful work of Anderson did not reveal a patterned response for  $B$  to unstable conditions. Consequently, we shall adopt (6.1) and (6.2) without change.

## VII. PRELIMINARY CALCULATIONS

In order to get a feeling for the equilibrium temperature and heat exchange coefficient, we shall calculate  $T_{eq}$  and  $K$  for a typical August day in Tampa, Florida. A useful heuristic tool for discussing the response to  $T_{eq}$  and  $K$  is the one-dimensional model of Duttweiler.<sup>(4)</sup> He considers the non-advective heat equation

$$\frac{h\partial T}{\partial t} = k(T_{eq} - T) \quad (7.1)$$

with  $T_{eq}$  expressed in a Fourier series and  $k$  a constant. Taking

$$T_{eq}(t) = T_m + T_i \sin(2\pi\nu t + \phi) \quad (7.2)$$

where  $T_m$  = time average value of  $T_{eq}$ ,  $T_i$  = amplitude of variation of  $T_{eq}$ ,  $\nu$  = frequency, and  $\phi$  = phase angle, he obtains

$$T(t) = T_m + T_i \left[ 1 + (2\pi\nu h/k)^2 \right]^{-1/2} \sin(2\pi\nu t + \phi - \alpha) \quad (7.3)$$

$$+ F(0) \exp(-kt/h)$$

where  $\nu = \tan^{-1}(2\pi\nu h/k)$ ,  $0 < \alpha < \pi/2$ , and  $F(0)$  is a transient depending on initial conditions. Assuming that the model makes sense qualitatively, we find for a period of 24 hours ( $= 1/\nu$ ) with  $k = .3 \times 10^{-4}$  ft/sec and  $h=10$ ft that the amplitude variation of the equilibrium temperature is about 25 times the amplitude variation of the water temperature. Also, since  $\alpha \approx \pi/2$  for short periods like a day, one finds that the maximum water temperature lags  $\alpha/2\pi\nu \approx 6$  hrs. behind the maximum equilibrium temperature.

An important consequence of these remarks is that the daily periodicity of  $T$  can be ignored insofar as  $K$  is concerned. This follows because  $K$  is essentially a function of  $(T + T_{eq})$  and the variation of  $T$  is negligible compared to that of  $T_{eq}$ . Of course, we must also consider the effect of spatial differences in  $T$ , particularly in the region near a high temperature outfall where  $K$  might be higher than in the rest of the bay.

Before dealing with this question, we calculate  $K$  and  $T_{eq}$  from the following data:

Average Meteorological Input

Solar declination =  $14^{\circ}\text{N}$

Maximum solar altitude =  $76^{\circ}$

Cloud cover = 6 tenths (C=6)

Cloud height = 7800 ft (h=7.8)

Cloud cover frequencies:  $F_c = 1.3\%$ ,  $F_s = 23\%$ ,  $F_b = 51.1\%$ ,  
 $F_o = 24.4\%$

Wind speed,  $W = 9\text{m.p.h.}$

Max (min) air temperature,  $T_a = 90/74^{\circ}$

Vapor pressure = .819 in Hg

Dew point temperature,  $T_d = 73^{\circ}\text{F}$

Bowen constant,  $B = .0102 \text{ in Hg } ^{\circ}\text{F}^{-1}$

Water temperature,  $T = 83^{\circ}\text{F}$

From equations (3.8) and (4.4) one obtains the maximum and minimum radiation flux:

$$(Q_{\text{net}} + Q_{\text{a net}}) = 365.5/123 \text{ Btu ft}^{-2} \text{ hr}^{-1} = \text{max/min} . \quad (7.4)$$

Substituting the radiation flux and the meteorological variables into equations (2.8) and (2.10), we obtain  $T_{\text{eq}}(\text{max}) = 103.6^{\circ}\text{F}$  after three iterations (beginning with a default value of  $120^{\circ}\text{F}$ ) and  $T_{\text{eq}}(\text{min}) = 71.4^{\circ}\text{F}$  after two iterations (beginning with  $70^{\circ}\text{F}$ ). Therefore, the max and min equilibrium temperatures for the entire bay are 103.6 and 71.4 respectively. From equation (2.12), the corresponding max and min values of the heat coefficient  $K$  are 9.23 and 6.68  $\text{Btu ft}^{-2} \text{ hr}^{-1} ^{\circ}\text{F}^{-1}$ . These yield values  $.419 \times 10^{-4}$  and  $.303 \times 10^{-4}$  ft/sec for  $K_{11} = K/\rho C_p$ .

Nearly all the difference in  $K$  between the maximum and minimum temperatures is due to the increased evaporation associated with the increased vapor pressure at the higher temperature. Very little change in  $K$  is caused by augmented back radiation. For the typical meteorological conditions considered, the percentage variation in  $K$  per degree temperature variation is approximately  $\Delta K/(K\Delta T) = 17/ ^{\circ}\text{F}$ . This value

declines to a minimum of  $1/3\% \text{ } ^\circ\text{F}^{-1}$  when evaporation is zero, at which point it is due to back radiation alone.

The previous remarks apply to variation of either  $T_{eq}$  or  $T$ . It appears therefore that high temperature outfalls would generate substantial deviation (10-20%) in  $K$ . Fortunately, most of this deviation is of no consequence. In particular, as stated by Edinger and Pritchard,<sup>(6)</sup> surface cooling is of relatively little importance in the initial and intermediate mixing zones. Only a small fraction of the discharged heat is dissipated into the atmosphere within the region where the temperature excess is 20% or more of the initial temperature excess. For example, if the water near the outfall is  $20^\circ\text{F}$  higher than the average for the waterbody (the temperature difference is usually smaller), most cooling occurs in water which has been diluted to less than  $4^\circ$  above average. Thus, in the area of principal concern  $K$  is less than 4% above its average for the bay. This discrepancy is probably less than errors involved in evaluating evaporation and conduction. The percentage variation in  $K$  per m.p.h. wind speed variation is  $\Delta K/K\Delta W = 100/W$  for typical evaporation rates. Therefore, if  $W$  is measured at 10 m.p.h. with  $1/2$  m.p.h. precision, then  $K$  is known with 5% accuracy. Values are given for the heat exchange coefficient and equilibrium temperature in tables 2 and 3 respectively. Note that equilibrium temperatures above the boiling point of water occur frequently for  $W=0$ . This may be taken to signify that molecular diffusion becomes important in those instances. One should therefore set  $W$  equal to some small value (e.g. take  $W_{min} = .4$  m.p.h.) to account effectively for free convection.

Table 2

Heat exchange coefficient in Btu per hour per square foot per degree Fahrenheit as a function of water temperature =T, equilibrium temperature =E, and wind speed =W.  
Mass transfer coefficient is M = .000231 corresponding to wind measurements at 2 meters in waterbody of 50,000 acres.

WATER TEMPERATURE = 55.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.87	1.72	2.58	3.44	4.29	6.00	7.72	9.43	11.14
45.0	.88	1.78	2.67	3.57	4.47	6.26	8.05	9.85	11.64
50.0	.89	1.83	2.77	3.71	4.65	6.53	8.41	10.29	12.17
55.0	.91	1.89	2.88	3.87	4.85	6.82	8.80	10.77	12.74
60.0	.92	1.96	2.99	4.03	5.06	7.14	9.21	11.28	13.35
65.0	.93	2.02	3.11	4.20	5.29	7.47	9.65	11.82	14.00
70.0	.95	2.09	3.24	4.38	5.53	7.82	10.11	12.40	14.70
75.0	.96	2.17	3.37	4.58	5.79	8.20	10.61	13.02	15.44
80.0	.98	2.26	3.55	4.84	6.13	8.71	11.29	13.86	16.44
85.0	.99	2.36	3.72	5.09	6.46	9.19	11.93	14.66	17.39
90.0	1.00	2.46	3.91	5.36	6.81	9.72	12.62	15.53	18.43
95.0	1.02	2.56	4.11	5.65	7.20	10.29	13.38	16.47	19.56
100.0	1.03	2.68	4.32	5.97	7.62	10.91	14.20	17.49	20.78
105.0	1.05	2.80	4.56	6.31	8.07	11.58	15.09	18.60	22.11
110.0	1.06	2.94	4.81	6.68	8.56	12.31	16.05	19.80	23.55
115.0	1.08	3.08	5.08	7.09	9.09	13.09	17.10	21.10	25.11
120.0	1.09	3.24	5.38	7.52	9.66	13.94	18.23	22.51	26.79
125.0	1.11	3.40	5.69	7.99	10.28	14.86	19.44	24.03	28.61
130.0	1.13	3.58	6.03	8.49	10.94	15.85	20.76	25.67	30.58

Table 2 (continued)

WATER TEMPERATURE = 60.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.88	1.78	2.67	3.57	4.47	6.26	8.05	9.85	11.64
45.0	.89	1.83	2.77	3.71	4.65	6.53	8.41	10.29	12.17
50.0	.91	1.89	2.88	3.87	4.85	6.82	8.80	10.77	12.74
55.0	.92	1.96	2.99	4.03	5.06	7.14	9.21	11.28	13.35
60.0	.93	2.02	3.11	4.20	5.29	7.47	9.65	11.82	14.00
65.0	.95	2.09	3.24	4.38	5.53	7.82	10.11	12.40	14.70
70.0	.96	2.17	3.37	4.58	5.79	8.20	10.61	13.02	15.44
75.0	.98	2.25	3.52	4.79	6.06	8.60	11.14	13.69	16.23
80.0	.99	2.33	3.67	5.01	6.35	9.03	11.71	14.39	17.07
85.0	1.00	2.44	3.87	5.30	6.74	9.60	12.47	15.33	18.20
90.0	1.02	2.54	4.06	5.58	7.10	10.15	13.19	16.23	19.28
95.0	1.03	2.65	4.27	5.89	7.50	10.74	13.97	17.21	20.44
100.0	1.05	2.77	4.49	6.21	7.93	11.38	14.82	18.26	21.71
105.0	1.06	2.90	4.73	6.57	8.40	12.07	15.74	19.41	23.08
110.0	1.08	3.04	4.99	6.95	8.91	12.82	16.74	20.65	24.57
115.0	1.09	3.18	5.27	7.36	9.45	13.63	17.81	21.99	26.17
120.0	1.11	3.34	5.58	7.81	10.04	14.51	18.98	23.44	27.91
125.0	1.12	3.51	5.90	8.29	10.68	15.45	20.23	25.01	29.79
130.0	1.14	3.70	6.25	8.81	11.36	16.47	21.59	26.70	31.81

WATER TEMPERATURE = 65.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.89	1.85	2.80	3.75	4.71	6.61	8.52	10.42	12.33
45.0	.91	1.89	2.88	3.87	4.85	6.82	8.80	10.77	12.74
50.0	.92	1.96	2.99	4.03	5.06	7.14	9.21	11.28	13.35
55.0	.93	2.02	3.11	4.20	5.29	7.47	9.65	11.82	14.00
60.0	.95	2.09	3.24	4.38	5.53	7.82	10.11	12.40	14.70
65.0	.96	2.17	3.37	4.58	5.79	8.20	10.61	13.02	15.44
70.0	.98	2.25	3.52	4.79	6.06	8.60	11.14	13.68	16.23
75.0	.99	2.33	3.67	5.01	6.35	9.03	11.71	14.39	17.07
80.0	1.00	2.42	3.83	5.24	6.66	9.48	12.31	15.14	17.96
85.0	1.02	2.51	4.00	5.49	6.98	9.97	12.95	15.93	18.92
90.0	1.03	2.63	4.23	5.82	7.42	10.61	13.80	17.00	20.19
95.0	1.05	2.74	4.44	6.13	7.83	11.22	14.61	18.01	21.40
100.0	1.06	2.87	4.67	6.47	8.28	11.89	15.49	19.10	22.71
105.0	1.08	3.00	4.92	6.84	8.76	12.60	16.44	20.29	24.13
110.0	1.09	3.14	5.19	7.23	9.28	13.38	17.47	21.57	25.66
115.0	1.11	3.29	5.48	7.66	9.85	14.21	18.58	22.95	27.32
120.0	1.12	3.46	5.79	8.12	10.45	15.12	19.78	24.45	29.11
125.0	1.14	3.63	6.12	8.61	11.11	16.09	21.07	26.06	31.04
130.0	1.16	3.82	6.48	9.15	11.81	17.14	22.47	27.80	33.12

Table 2 (continued)

WATER TEMPERATURE = 70.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.91	1.91	2.92	3.93	4.93	6.94	8.95	10.97	12.98
45.0	.92	1.97	3.02	4.07	5.12	7.22	9.32	11.42	13.52
50.0	.93	2.02	3.11	4.20	5.29	7.47	9.65	11.82	14.00
55.0	.95	2.09	3.24	4.38	5.53	7.82	10.11	12.40	14.70
60.0	.96	2.17	3.37	4.58	5.79	8.20	10.61	13.02	15.44
65.0	.98	2.25	3.52	4.79	6.06	8.60	11.14	13.68	16.23
70.0	.99	2.33	3.67	5.01	6.35	9.03	11.71	14.39	17.07
75.0	1.00	2.42	3.83	5.24	6.66	9.48	12.31	15.14	17.96
80.0	1.02	2.51	4.00	5.49	6.98	9.97	12.95	15.93	18.92
85.0	1.03	2.61	4.18	5.76	7.33	10.48	13.63	16.78	19.93
90.0	1.05	2.71	4.37	6.04	7.70	11.02	14.35	17.68	21.00
95.0	1.06	2.84	4.62	6.40	8.18	11.75	15.31	18.87	22.43
100.0	1.08	2.97	4.86	6.75	8.65	12.43	16.22	20.00	23.79
105.0	1.09	3.11	5.12	7.13	9.15	13.17	17.20	21.23	25.25
110.0	1.11	3.25	5.40	7.54	9.68	13.97	18.26	22.55	26.84
115.0	1.12	3.41	5.69	7.98	10.27	14.84	19.41	23.98	28.55
120.0	1.14	3.58	6.01	8.45	10.89	15.77	20.64	25.52	30.40
125.0	1.15	3.76	6.36	8.96	11.57	16.77	21.98	27.18	32.39
130.0	1.17	3.95	6.73	9.51	12.29	17.85	23.41	28.97	34.53

WATER TEMPERATURE = 75.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.92	1.99	3.05	4.11	5.18	7.31	9.43	11.56	13.69
45.0	.93	2.05	3.16	4.27	5.38	7.60	9.82	12.04	14.27
50.0	.95	2.11	3.27	4.43	5.60	7.92	10.24	12.57	14.89
55.0	.96	2.17	3.37	4.58	5.79	8.20	10.61	13.02	15.44
60.0	.98	2.25	3.52	4.79	6.06	8.60	11.14	13.69	16.23
65.0	.99	2.33	3.67	5.01	6.35	9.03	11.71	14.39	17.07
70.0	1.00	2.42	3.83	5.24	6.66	9.48	12.31	15.14	17.96
75.0	1.02	2.51	4.00	5.49	6.98	9.97	12.95	15.93	18.92
80.0	1.03	2.61	4.18	5.76	7.33	10.48	13.63	16.78	19.93
85.0	1.05	2.71	4.37	6.04	7.70	11.02	14.35	17.68	21.00
90.0	1.06	2.82	4.57	6.33	8.09	11.60	15.12	18.63	22.14
95.0	1.08	2.93	4.79	6.65	8.50	12.21	15.93	19.64	23.35
100.0	1.09	3.08	5.07	7.06	9.04	13.02	17.00	20.97	24.95
105.0	1.11	3.22	5.33	7.45	9.56	13.79	18.01	22.24	26.47
110.0	1.12	3.37	5.62	7.87	10.12	14.61	19.11	23.61	28.11
115.0	1.14	3.53	5.93	8.32	10.72	15.51	20.30	25.08	29.87
120.0	1.15	3.71	6.26	8.81	11.36	16.47	21.57	26.67	31.78
125.0	1.17	3.89	6.61	9.33	12.06	17.50	22.94	28.39	33.83
130.0	1.19	4.09	6.99	9.90	12.80	18.61	24.42	30.23	36.04

Table 2 (continued)

WATER TEMPERATURE = 80.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.94	2.06	3.19	4.32	5.45	7.70	9.96	12.12	14.47
45.0	.95	2.13	3.30	4.48	5.66	8.01	10.37	12.72	15.08
50.0	.96	2.19	3.42	4.65	5.88	8.35	10.81	13.27	15.73
55.0	.98	2.26	3.55	4.84	6.13	8.71	11.29	13.86	16.44
60.0	.99	2.33	3.67	5.01	6.35	9.03	11.71	14.39	17.07
65.0	1.00	2.42	3.83	5.24	6.66	9.48	12.31	15.14	17.96
70.0	1.02	2.51	4.00	5.49	6.98	9.97	12.95	15.93	18.92
75.0	1.03	2.61	4.18	5.76	7.33	10.48	13.63	16.78	19.93
80.0	1.05	2.71	4.37	6.04	7.70	11.02	14.35	17.68	21.00
85.0	1.06	2.82	4.57	6.33	8.09	11.60	15.12	18.63	22.14
90.0	1.08	2.93	4.79	6.64	8.50	12.21	15.93	19.64	23.35
95.0	1.09	3.05	5.01	6.98	8.94	12.86	16.79	20.71	24.64
100.0	1.11	3.18	5.25	7.33	9.40	13.55	17.70	21.84	25.99
105.0	1.12	3.34	5.56	7.78	10.01	14.45	18.89	23.33	27.77
110.0	1.14	3.50	5.86	8.22	10.58	15.30	20.02	24.75	29.47
115.0	1.15	3.66	6.18	8.69	11.20	16.22	21.25	26.27	31.29
120.0	1.17	3.84	6.52	9.19	11.87	17.21	22.56	27.91	33.26
125.0	1.18	4.03	6.88	9.73	12.58	18.28	23.98	29.68	35.37
130.0	1.20	4.24	7.27	10.31	13.35	19.42	25.50	31.57	37.65

WATER TEMPERATURE = 85.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.95	2.15	3.35	4.54	5.74	8.14	10.53	12.93	15.33
45.0	.96	2.21	3.46	4.71	5.96	8.46	10.96	13.46	15.96
50.0	.98	2.28	3.59	4.89	6.20	8.81	11.42	14.04	16.65
55.0	.99	2.36	3.72	5.09	6.46	9.19	11.93	14.66	17.39
60.0	1.00	2.44	3.87	5.30	6.74	9.60	12.47	15.33	18.20
65.0	1.02	2.51	4.00	5.49	6.98	9.97	12.95	15.93	18.92
70.0	1.03	2.61	4.18	5.76	7.33	10.48	13.63	16.78	19.93
75.0	1.05	2.71	4.37	6.04	7.70	11.02	14.35	17.68	21.00
80.0	1.06	2.82	4.57	6.33	8.09	11.60	15.12	18.63	22.14
85.0	1.08	2.93	4.79	6.64	8.50	12.21	15.93	19.64	23.35
90.0	1.09	3.05	5.01	6.98	8.94	12.86	16.79	20.71	24.63
95.0	1.11	3.18	5.25	7.33	9.40	13.55	17.70	21.84	25.99
100.0	1.12	3.31	5.51	7.70	9.89	14.27	18.66	23.04	27.43
105.0	1.14	3.45	5.77	8.09	10.41	15.04	19.68	24.31	28.95
110.0	1.15	3.63	6.11	8.60	11.08	16.04	21.00	25.97	30.93
115.0	1.17	3.81	6.44	9.08	11.72	16.99	22.27	27.54	32.82
120.0	1.18	3.99	6.79	9.60	12.40	18.01	23.62	29.24	34.85
125.0	1.20	4.19	7.17	10.16	13.14	19.11	25.08	31.05	37.03
130.0	1.22	4.40	7.57	10.75	13.93	20.29	26.65	33.01	39.37

Table 2 (continued)

WATER TEMPERATURE = 90.0 DEGREES FAHRENHEIT

Eq Temp	W=0	W=2.5	W=5.0	W=7.5	W=10	W=15	W=20	W=25	W=30
40.0	.96	2.24	3.51	4.79	6.06	8.61	11.16	13.71	16.26
45.0	.98	2.31	3.64	4.96	6.29	8.95	11.61	14.27	16.93
50.0	.99	2.38	3.77	5.15	6.54	9.32	12.10	14.87	17.65
55.0	1.00	2.46	3.91	5.36	6.81	9.72	12.62	15.53	18.43
60.0	1.02	2.54	4.06	5.58	7.10	10.15	13.19	16.23	19.28
65.0	1.03	2.63	4.23	5.82	7.42	10.61	13.80	17.00	20.19
70.0	1.05	2.71	4.37	6.04	7.70	11.02	14.35	17.68	21.00
75.0	1.06	2.82	4.57	6.33	8.09	11.60	15.12	18.63	22.14
80.0	1.08	2.93	4.79	6.64	8.50	12.21	15.93	19.64	23.35
85.0	1.09	3.05	5.01	6.98	8.94	12.86	16.79	20.71	24.63
90.0	1.11	3.18	5.25	7.33	9.40	13.55	17.70	21.84	25.99
95.0	1.12	3.31	5.51	7.70	9.89	14.27	18.66	23.04	27.43
100.0	1.14	3.45	5.77	8.09	10.41	15.04	19.68	24.31	28.95
105.0	1.15	3.60	6.05	8.50	10.95	15.85	20.75	25.65	30.55
110.0	1.17	3.76	6.35	8.94	11.53	16.71	21.89	27.07	32.25
115.0	1.18	3.96	6.73	9.50	12.27	17.82	23.36	28.91	34.45
120.0	1.20	4.14	7.09	10.04	12.98	18.87	24.76	30.65	36.55
125.0	1.22	4.35	7.48	10.61	13.74	20.00	26.27	32.53	38.79
130.0	1.23	4.56	7.89	11.23	14.56	21.22	27.88	34.54	41.21

Table 3

DEWPOINT TEMPERATURE = R = 25.0  
AIR TEMPERATURE = T = 25.0

Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	18.8	21.2	22.9	22.9	23.3	23.5	23.7
100.0	35.3	29.0	27.5	26.8	26.4	26.2	26.0	25.9
120.0	58.5	38.2	33.3	31.1	29.8	29.0	28.4	27.9
140.0	78.8	46.4	38.8	35.2	33.1	31.7	30.7	30.0
160.0	97.1	53.9	43.8	39.0	36.2	34.3	33.0	32.0
180.0	113.8	60.6	48.6	42.7	39.2	36.8	35.1	33.9
200.0	129.1	66.7	53.0	46.2	42.0	39.3	37.3	35.8
220.0	143.3	72.2	57.1	49.5	44.8	41.6	39.3	37.6
240.0	156.5	77.3	61.0	52.6	47.4	43.9	41.3	39.4
260.0	169.0	82.0	64.6	55.6	50.0	46.1	43.3	41.1
280.0	180.8	86.3	68.0	58.4	52.4	48.2	45.2	42.8
300.0	191.9	90.3	71.2	61.1	54.7	50.3	47.0	44.5
320.0	202.5	94.1	74.2	63.7	57.0	52.3	48.8	46.1
340.0	212.6	97.5	77.1	66.2	59.1	54.2	50.5	47.6
360.0	222.3	100.8	79.8	68.5	61.2	56.0	52.2	49.2
380.0	231.6	103.9	82.4	70.8	63.2	57.8	53.8	50.6
400.0	240.5	106.9	84.9	72.9	65.1	59.6	55.4	52.1
420.0	249.1	109.6	87.2	75.0	67.0	61.3	56.9	53.5
440.0	257.4	112.3	89.5	77.0	68.8	62.9	58.4	54.9
460.0	265.4	114.8	91.6	78.9	70.5	64.5	59.9	56.2

Equilibrium temperature as a function of net solar and atmospheric radiation [Q(net) + Q(atm)], dewpoint temperature (R), V<sub>e</sub> (air temperature (T) - dewpoint temperature (R)), and wind speed (W).  
Mass transfer coefficient (H) corresponds to 50,000 acre waterbody with measurements at 2 meters above surface (H may be adjusted by modifying W input by appropriate factor). All temperatures are in degrees Fahrenheit, heat flux in Btu per square foot per hour, wind speed in m.p.h., pressure in inches Hg.

-25-

DEWPOINT TEMPERATURE = R = 30.0  
AIR TEMPERATURE = T = 30.0

Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	22.2	25.3	26.6	27.4	27.8	28.2	28.4
100.0	35.3	32.0	31.2	30.9	30.7	30.6	30.5	30.4
120.0	58.5	40.9	36.8	35.0	33.9	33.2	32.7	32.4
140.0	78.8	48.8	42.0	38.8	37.0	35.8	34.9	34.3
160.0	97.1	56.0	46.9	42.5	39.9	38.3	37.1	36.2
180.0	113.8	62.6	51.4	46.0	42.8	40.6	39.1	38.0
200.0	129.1	68.5	55.6	49.3	45.5	42.9	41.1	39.8
220.0	143.3	73.9	59.5	52.4	48.1	45.2	43.1	41.5
240.0	156.5	78.8	63.2	55.4	50.6	47.3	45.0	43.2
260.0	169.0	83.4	66.7	58.2	53.0	49.4	46.8	44.8
280.0	180.8	87.6	70.0	60.9	55.3	51.4	48.6	46.4
300.0	191.9	91.5	73.1	63.5	57.5	53.4	50.3	47.9
320.0	202.5	95.1	76.0	66.0	59.7	55.2	52.0	49.5
340.0	212.6	98.6	78.8	68.4	61.7	57.1	53.6	50.9
360.0	222.3	101.8	81.4	70.6	63.7	58.8	55.2	52.4
380.0	231.6	104.8	83.9	72.8	65.6	60.5	56.7	53.8
400.0	240.5	107.7	86.3	74.9	67.4	62.2	58.2	55.2
420.0	249.1	110.5	88.6	76.9	69.2	63.8	59.7	56.5
440.0	257.4	113.1	90.8	78.8	70.9	65.3	61.1	57.8
460.0	265.4	115.5	92.9	80.7	72.6	66.9	62.5	59.1

DEWPOINT TEMPERATURE = R = 20.0  
AIR TEMPERATURE = T = 20.0

Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	15.6	17.3	18.0	18.5	18.7	18.9	19.1
100.0	35.3	26.1	23.8	22.8	22.2	21.8	21.5	21.3
120.0	58.5	35.5	29.9	27.3	25.7	24.7	24.0	23.5
140.0	78.8	44.1	35.6	31.5	29.2	27.6	26.5	25.7
160.0	97.1	51.8	40.6	35.6	32.5	30.4	28.9	27.8
180.0	113.8	58.7	45.8	39.4	35.6	33.0	31.2	29.8
200.0	129.1	65.0	50.4	43.1	38.6	35.6	33.4	31.8
220.0	143.3	70.7	54.7	46.6	41.5	38.1	35.6	33.7
240.0	156.5	75.9	58.7	49.8	44.3	40.5	37.7	35.6
260.0	169.0	80.7	62.5	53.0	47.0	42.8	39.8	37.5
280.0	180.8	85.1	66.0	55.9	49.5	45.1	41.8	39.2
300.0	191.9	89.2	69.3	58.7	52.0	47.2	43.7	41.0
320.0	202.5	93.0	72.5	61.4	54.3	49.3	45.6	42.7
340.0	212.6	96.6	75.4	64.0	56.6	51.3	47.4	44.3
360.0	222.3	99.9	78.3	66.5	58.8	53.3	49.2	46.0
380.0	231.6	103.1	80.9	68.8	60.8	55.2	50.9	47.5
400.0	240.5	106.0	83.5	71.0	62.9	57.0	52.5	49.1
420.0	249.1	108.9	85.9	73.2	64.8	58.8	54.2	50.5
440.0	257.4	111.5	88.2	75.3	66.7	60.5	55.7	52.0
460.0	265.4	114.1	90.4	77.3	68.5	62.1	57.3	53.4

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 45.0 AIR TEMPERATURE = T = 45.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	33.0	38.0	40.0	41.2	41.9	42.4	42.7	
100.0	35.3	41.7	43.1	43.6	43.9	44.1	44.3	44.4	
120.0	58.5	49.6	47.8	47.0	46.6	46.3	46.1	46.0	
140.0	78.8	56.7	52.2	50.2	49.1	48.4	47.9	47.5	
160.0	97.1	63.1	56.4	53.3	51.6	50.4	49.6	49.0	
180.0	113.8	69.0	60.3	56.2	53.9	52.4	51.3	50.5	
200.0	129.1	74.3	63.9	59.0	56.2	54.3	52.9	51.9	
220.0	143.3	79.2	67.3	61.7	58.3	56.1	54.5	53.4	
240.0	156.5	83.7	70.6	64.2	60.4	57.9	56.1	54.7	
260.0	169.0	87.9	73.6	66.7	62.5	59.6	57.6	56.1	
280.0	180.8	91.8	76.5	69.0	64.4	61.3	59.1	57.4	
300.0	191.9	95.4	79.2	71.2	66.3	62.9	60.5	58.7	
320.0	202.5	98.8	81.9	73.3	68.1	64.5	61.9	59.9	
340.0	212.6	102.0	84.3	75.4	69.8	66.0	63.3	61.1	
360.0	222.3	105.1	86.7	77.4	71.5	67.5	64.6	62.3	
380.0	231.6	107.9	89.0	79.3	73.2	69.0	65.9	63.5	
400.0	240.5	110.6	91.1	81.1	74.8	70.4	67.1	64.6	
420.0	249.1	113.2	93.2	82.9	76.3	71.8	68.4	65.8	
440.0	257.4	115.7	95.2	84.6	77.8	73.1	69.6	66.9	
460.0	265.4	118.1	97.1	86.2	79.3	74.4	70.8	67.9	

DEWPOINT TEMPERATURE = R = 50.0 AIR TEMPERATURE = T = 50.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	37.0	42.4	44.7	45.9	46.7	47.2	47.6	
100.0	35.3	45.3	47.2	48.0	48.5	48.7	48.9	49.1	
120.0	58.5	52.8	51.7	51.2	50.9	50.8	50.6	50.6	
140.0	78.8	59.6	55.8	54.2	53.3	52.7	52.3	52.0	
160.0	97.1	65.7	59.8	57.1	55.6	54.6	53.9	53.4	
180.0	113.8	71.3	63.4	59.8	57.8	56.4	55.5	54.8	
200.0	129.1	76.4	66.9	62.4	59.9	58.2	57.0	56.1	
220.0	143.3	81.2	70.1	64.9	61.9	59.9	58.5	57.4	
240.0	156.5	85.5	73.2	67.3	63.9	61.6	59.9	58.7	
260.0	169.0	89.6	76.1	69.6	65.8	63.2	61.3	59.9	
280.0	180.8	93.3	78.9	71.8	67.6	64.8	62.7	61.2	
300.0	191.9	96.9	81.5	73.9	69.4	66.3	64.0	62.4	
320.0	202.5	100.2	84.0	76.0	71.1	67.8	65.3	63.5	
340.0	212.6	103.3	86.4	77.9	72.7	69.2	66.6	64.7	
360.0	222.3	106.3	88.6	79.8	74.3	70.6	67.9	65.8	
380.0	231.6	109.1	90.8	81.6	75.9	72.0	69.1	66.9	
400.0	240.5	111.7	92.9	83.4	77.4	73.3	70.3	67.9	
420.0	249.1	114.3	94.9	85.0	78.9	74.6	71.4	69.0	
440.0	257.4	116.7	96.9	86.7	80.3	75.8	72.6	70.0	
460.0	265.4	119.0	98.7	88.3	81.7	77.1	73.7	71.0	

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 65.0 AIR TEMPERATURE = T = 65.0									
Q=	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	41.0	47.0	49.4	50.7	51.5	52.1	52.5	
100.0	35.3	48.9	51.5	52.5	53.1	53.4	53.7	53.9	
120.0	58.5	56.1	55.6	55.5	55.4	55.3	55.2	55.2	
140.0	78.8	62.5	58.6	58.3	57.5	57.1	56.8	56.5	
160.0	97.1	68.4	63.2	61.0	59.7	58.8	58.3	57.8	
180.0	113.8	73.8	66.7	63.5	61.7	60.5	59.7	59.1	
200.0	129.1	78.7	69.9	66.0	63.7	62.2	61.1	60.3	
220.0	143.3	83.2	73.0	68.3	65.6	63.8	62.5	61.5	
240.0	156.5	87.5	75.9	70.6	67.4	65.3	63.8	62.7	
260.0	169.0	91.4	78.7	72.7	69.2	66.8	65.1	63.9	
280.0	180.8	95.0	81.3	74.8	70.9	68.3	66.4	65.0	
300.0	191.9	98.4	83.8	76.8	72.5	69.7	67.7	66.1	
320.0	202.5	101.7	86.2	78.7	74.1	71.1	68.9	67.2	
340.0	212.6	104.7	88.5	80.5	75.7	72.4	70.1	68.3	
360.0	222.3	107.6	90.7	82.3	77.2	73.7	71.2	69.3	
380.0	231.6	110.3	92.8	84.0	78.7	75.0	72.4	70.3	
400.0	240.5	112.9	94.8	85.7	80.1	76.3	73.5	71.3	
420.0	249.1	115.4	96.7	87.3	81.5	77.5	74.6	72.3	
440.0	257.4	117.8	98.6	88.9	82.9	78.7	75.6	73.3	
460.0	265.4	120.0	100.4	90.4	84.2	79.8	76.7	74.2	

DEWPOINT TEMPERATURE = R = 60.0 AIR TEMPERATURE = T = 60.0									
Q=	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	45.3	51.7	54.2	55.6	56.4	57.0	57.4	
100.0	35.3	52.8	55.8	57.1	57.7	58.2	58.5	58.7	
120.0	58.5	59.5	59.7	59.8	59.9	59.9	59.9	59.9	
140.0	78.8	65.7	63.4	62.4	61.9	61.5	61.3	61.1	
160.0	97.1	71.3	66.8	64.9	63.8	63.1	62.7	62.3	
180.0	113.8	76.4	70.1	67.3	65.7	64.7	64.0	63.5	
200.0	129.1	81.1	73.1	69.6	67.5	66.2	65.3	64.6	
220.0	143.3	85.5	76.0	71.8	69.3	67.7	66.6	65.7	
240.0	156.5	89.5	78.8	73.9	71.0	69.1	67.8	66.8	
260.0	169.0	93.3	81.4	75.9	72.7	70.5	69.0	67.9	
280.0	180.8	96.8	83.9	77.8	74.3	71.9	70.2	68.9	
300.0	191.9	100.1	86.3	79.7	75.8	73.2	71.4	70.0	
320.0	202.5	103.2	88.6	81.5	77.3	74.5	72.5	71.0	
340.0	212.6	106.2	90.7	83.3	78.8	75.8	73.6	71.9	
360.0	222.3	109.0	92.8	85.0	80.2	77.0	74.7	72.9	
380.0	231.6	111.7	94.8	86.6	81.6	78.2	75.7	73.9	
400.0	240.5	114.2	96.8	88.2	82.9	79.4	76.8	74.8	
420.0	249.1	116.6	99.6	89.7	84.2	80.5	77.4	75.7	
440.0	257.4	118.9	100.4	91.2	85.5	81.6	78.8	76.6	
460.0	265.4	121.1	102.2	92.7	86.8	82.7	79.8	77.5	

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 75.0 AIR TEMPERATURE = T = 75.0																	
Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	59.1	66.3	69.1	70.5	71.4	71.9	72.4	80.0	8.5	59.1	66.3	69.1	70.5	71.4	71.9	72.4
100.0	35.3	65.2	69.6	71.3	72.1	72.7	73.1	73.3	100.0	35.3	65.2	69.6	71.3	72.1	72.7	73.1	73.3
120.0	58.5	70.8	72.6	73.4	73.7	74.0	74.1	74.3	120.0	58.5	70.8	72.6	73.4	73.7	74.0	74.1	74.3
140.0	78.8	76.0	75.6	75.4	75.3	75.2	75.2	75.2	140.0	78.8	76.0	75.6	75.4	75.3	75.2	75.2	75.2
160.0	97.1	80.7	78.3	77.3	76.8	76.5	76.2	76.1	160.0	97.1	80.7	78.3	77.3	76.8	76.5	76.2	76.1
180.0	113.8	85.1	80.9	79.2	78.3	77.7	77.3	77.0	180.0	113.8	85.1	80.9	79.2	78.3	77.7	77.3	77.0
200.0	129.1	89.1	83.4	81.0	79.7	78.9	78.3	77.8	200.0	129.1	89.1	83.4	81.0	79.7	78.9	78.3	77.8
220.0	143.3	92.9	85.8	82.8	81.1	80.0	79.3	78.7	220.0	143.3	92.9	85.8	82.8	81.1	80.0	79.3	78.7
240.0	156.5	96.4	88.1	84.5	82.5	81.1	80.2	79.5	240.0	156.5	96.4	88.1	84.5	82.5	81.1	80.2	79.5
260.0	169.0	99.8	90.3	86.1	83.8	82.2	81.2	80.4	260.0	169.0	99.8	90.3	86.1	83.8	82.2	81.2	80.4
280.0	180.8	102.9	92.4	87.7	85.1	83.3	82.1	81.2	280.0	180.8	102.9	92.4	87.7	85.1	83.3	82.1	81.2
300.0	191.9	105.9	94.4	89.3	86.3	84.4	83.0	82.0	300.0	191.9	105.9	94.4	89.3	86.3	84.4	83.0	82.0
320.0	202.5	108.7	96.4	90.8	87.5	85.4	83.9	82.8	320.0	202.5	108.7	96.4	90.8	87.5	85.4	83.9	82.8
340.0	212.6	111.3	98.2	92.2	88.7	86.4	84.8	83.5	340.0	212.6	111.3	98.2	92.2	88.7	86.4	84.8	83.5
360.0	222.3	113.9	100.0	93.6	89.9	87.4	85.6	84.3	360.0	222.3	113.9	100.0	93.6	89.9	87.4	85.6	84.3
380.0	231.6	116.3	101.8	95.0	91.0	88.4	86.5	85.0	380.0	231.6	116.3	101.8	95.0	91.0	88.4	86.5	85.0
400.0	240.5	118.6	103.5	96.3	92.1	89.3	87.3	85.8	400.0	240.5	118.6	103.5	96.3	92.1	89.3	87.3	85.8
420.0	249.1	120.9	105.1	97.6	93.2	90.2	88.1	86.5	420.0	249.1	120.9	105.1	97.6	93.2	90.2	88.1	86.5
440.0	257.4	123.0	106.7	98.9	94.3	91.2	88.9	87.2	440.0	257.4	123.0	106.7	98.9	94.3	91.2	88.9	87.2
460.0	265.4	125.1	108.2	100.1	95.3	92.1	89.7	87.9	460.0	265.4	125.1	108.2	100.1	95.3	92.1	89.7	87.9

DEWPOINT TEMPERATURE = R = 80.0  
AIR TEMPERATURE = T = 80.0

Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	64.0	71.4	74.1	75.5	76.4	77.0	77.4	80.0	8.5	64.0	71.4	74.1	75.5	76.4	77.0	77.4
100.0	35.3	69.7	74.3	76.1	77.0	77.6	78.0	78.3	100.0	35.3	69.7	74.3	76.1	77.0	77.6	78.0	78.3
120.0	58.5	74.9	77.2	78.0	78.5	78.8	79.0	79.1	120.0	58.5	74.9	77.2	78.0	78.5	78.8	79.0	79.1
140.0	78.8	79.7	79.8	79.9	79.9	79.9	79.9	79.9	140.0	78.8	79.7	79.8	79.9	79.9	79.9	79.9	79.9
160.0	97.1	84.1	82.4	81.7	81.3	81.1	80.9	80.8	160.0	97.1	84.1	82.4	81.7	81.3	81.1	80.9	80.8
180.0	113.8	88.3	84.8	83.4	82.6	82.2	81.8	81.6	180.0	113.8	88.3	84.8	83.4	82.6	82.2	81.8	81.6
200.0	129.1	92.1	87.1	85.1	83.9	83.2	82.7	82.4	200.0	129.1	92.1	87.1	85.1	83.9	83.2	82.7	82.4
220.0	143.3	95.7	89.4	86.7	85.2	84.3	83.6	83.1	220.0	143.3	95.7	89.4	86.7	85.2	84.3	83.6	83.1
240.0	156.5	99.0	91.5	88.3	86.5	85.3	84.5	83.9	240.0	156.5	99.0	91.5	88.3	86.5	85.3	84.5	83.9
260.0	169.0	102.2	93.5	89.8	87.7	86.7	85.4	84.7	260.0	169.0	102.2	93.5	89.8	87.7	86.7	85.4	84.7
280.0	180.8	105.2	95.5	91.3	88.9	87.3	86.2	85.4	280.0	180.8	105.2	95.5	91.3	88.9	87.3	86.2	85.4
300.0	191.9	108.0	97.4	92.7	90.0	88.3	87.0	86.1	300.0	191.9	108.0	97.4	92.7	90.0	88.3	87.0	86.1
320.0	202.5	110.7	99.2	94.1	91.1	89.2	87.9	86.9	320.0	202.5	110.7	99.2	94.1	91.1	89.2	87.9	86.9
340.0	212.6	113.3	101.0	95.5	92.3	90.2	88.7	87.6	340.0	212.6	113.3	101.0	95.5	92.3	90.2	88.7	87.6
360.0	222.3	115.8	102.7	96.8	93.3	91.1	89.5	88.3	360.0	222.3	115.8	102.7	96.8	93.3	91.1	89.5	88.3
380.0	231.6	118.1	104.4	98.1	94.4	92.0	90.3	89.0	380.0	231.6	118.1	104.4	98.1	94.4	92.0	90.3	89.0
400.0	240.5	120.4	106.0	99.3	95.4	92.9	91.0	89.6	400.0	240.5	120.4	106.0	99.3	95.4	92.9	91.0	89.6
420.0	249.1	122.5	107.5	100.5	96.4	93.7	91.8	90.3	420.0	249.1	122.5	107.5	100.5	96.4	93.7	91.8	90.3
440.0	257.4	124.6	109.0	101.7	97.4	94.6	92.5	91.0	440.0	257.4	124.6	109.0	101.7	97.4	94.6	92.5	91.0
460.0	265.4	126.6	110.5	102.9	98.4	95.4	93.3	91.6	460.0	265.4	126.6	110.5	102.9	98.4	95.4	93.3	91.6

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 95.0 AIR TEMPERATURE = T = 95.0									
Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	W=40
80.0	8.5	19.9	22.5	23.6	24.3	24.7	25.0	25.2	25.4
100.0	35.3	29.9	28.7	28.1	27.8	27.5	27.4	27.3	27.2
120.0	58.5	39.0	34.4	32.3	31.1	30.3	29.8	29.3	28.8
140.0	78.8	47.2	39.8	36.3	34.3	33.0	32.0	31.3	30.6
160.0	97.1	54.5	44.8	40.1	37.4	35.5	34.2	33.3	32.4
180.0	113.8	61.2	49.4	43.7	40.3	38.0	36.4	35.2	34.1
200.0	129.1	67.2	53.8	47.1	43.1	40.4	38.5	37.0	35.7
220.0	143.3	72.7	57.9	50.4	45.8	42.7	40.5	38.8	37.3
240.0	156.5	77.8	61.7	53.5	48.4	45.0	42.5	40.6	39.0
260.0	169.0	82.4	65.2	56.4	50.9	47.1	44.4	42.3	40.5
280.0	180.8	86.7	68.6	59.2	53.3	49.2	46.2	43.9	41.8
300.0	191.9	90.7	71.8	61.9	55.6	51.2	48.0	45.5	43.2
320.0	202.5	94.4	74.8	64.4	57.8	53.2	49.8	47.1	44.7
340.0	212.6	97.9	77.6	66.8	59.9	55.1	51.5	48.7	46.1
360.0	222.3	101.1	80.3	69.2	62.0	56.9	53.1	50.2	47.4
380.0	231.6	104.2	82.9	71.4	63.9	58.7	54.7	51.6	48.6
400.0	240.5	107.1	85.3	73.5	65.9	60.4	56.3	53.1	49.8
420.0	249.1	109.9	87.7	75.6	67.7	62.0	57.8	54.4	50.9
440.0	257.4	112.5	89.9	77.6	69.5	63.7	59.3	55.8	52.3
460.0	265.4	115.0	92.0	79.5	71.2	65.2	60.7	57.1	53.7

DEWPOINT TEMPERATURE = R = 25.0 AIR TEMPERATURE = T = 35.0									
Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	W=40
80.0	8.5	23.0	26.2	27.6	28.4	28.9	29.3	29.5	29.7
100.0	35.3	32.7	32.1	31.9	31.7	31.6	31.5	31.5	31.5
120.0	58.5	41.5	37.6	35.9	34.9	34.2	33.8	33.4	33.1
140.0	78.8	49.4	42.8	39.7	37.9	36.7	35.9	35.3	34.7
160.0	97.1	56.6	47.6	43.3	40.8	39.2	38.0	37.2	36.4
180.0	113.8	63.0	52.0	46.8	43.6	41.5	40.1	38.9	37.8
200.0	129.1	68.9	56.2	50.0	46.3	43.8	42.0	40.7	39.5
220.0	143.3	74.2	60.1	53.1	48.9	46.0	43.9	42.4	41.1
240.0	156.5	79.2	63.6	56.1	51.3	48.1	45.8	44.0	42.5
260.0	169.0	83.7	67.2	58.9	53.7	50.2	47.6	45.7	43.9
280.0	180.8	87.9	70.5	61.6	56.0	52.2	49.4	47.2	45.3
300.0	191.9	91.8	73.5	64.1	58.2	54.1	51.1	48.8	46.7
320.0	202.5	95.4	76.5	66.5	60.3	55.9	52.7	50.3	48.1
340.0	212.6	98.8	79.2	68.9	62.3	57.7	54.3	51.7	49.1
360.0	222.3	102.0	81.8	71.1	64.3	59.5	55.9	53.1	50.3
380.0	231.6	105.1	84.3	73.3	66.2	61.2	57.4	54.5	51.5
400.0	240.5	107.9	86.7	75.3	68.0	62.8	58.9	55.9	52.8
420.0	249.1	110.7	89.0	77.3	69.8	64.4	60.3	57.2	54.1
440.0	257.4	113.2	91.1	79.2	71.5	65.9	61.8	58.5	55.3
460.0	265.4	115.7	93.2	81.1	73.1	67.4	63.1	59.7	56.4

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 30.0 AIR TEMPERATURE = T = 40.0													DEWPOINT TEMPERATURE = R = 40.0 AIR TEMPERATURE = T = 50.0													
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	26.2	30.0	31.7	32.6	33.2	33.6	32.9	80.0	8.5	33.0	37.3	40.0	41.1	41.8	42.3	42.6	100.0	35.3	41.7	43.0	43.5	43.9	44.1	44.2	44.3
100.0	35.3	35.6	35.7	35.7	35.7	35.7	35.7	35.7	100.0	35.3	41.7	43.0	43.5	43.9	44.1	44.2	44.3	120.0	58.5	49.6	47.7	47.0	46.5	46.2	46.0	45.9
120.0	58.5	44.1	40.9	39.5	38.7	38.2	37.8	37.5	120.0	58.5	49.6	47.7	47.0	46.5	46.2	46.0	45.9	140.0	78.8	56.7	52.2	50.2	49.1	48.3	47.8	47.4
140.0	78.8	51.7	45.8	43.1	41.6	40.6	39.9	39.3	140.0	78.8	56.7	52.2	50.2	49.1	48.3	47.8	47.4	160.0	97.1	63.1	56.3	53.3	51.5	50.4	49.6	49.0
160.0	97.1	58.7	50.4	46.6	44.3	42.9	41.8	41.1	160.0	97.1	63.1	56.3	53.3	51.5	50.4	49.6	49.0	180.0	113.8	68.9	60.2	56.2	53.9	52.3	51.2	50.4
180.0	113.8	64.9	54.7	49.8	47.0	45.1	43.7	42.7	180.0	113.8	68.9	60.2	56.2	53.9	52.3	51.2	50.4	200.0	129.1	74.3	63.9	59.0	56.1	54.2	52.9	51.9
200.0	129.1	70.6	58.7	52.9	49.5	47.2	45.6	44.4	200.0	129.1	74.3	63.9	59.0	56.1	54.2	52.9	51.9	220.0	143.3	79.2	67.3	61.6	58.3	56.1	54.5	53.3
220.0	143.3	73.8	62.4	55.9	52.0	49.3	47.4	46.0	220.0	143.3	79.2	67.3	61.6	58.3	56.1	54.5	53.3	240.0	156.5	83.7	70.5	64.2	60.4	57.9	56.0	54.7
240.0	156.5	80.6	66.0	58.7	54.3	51.3	49.2	47.5	240.0	156.5	83.7	70.5	64.2	60.4	57.9	56.0	54.7	260.0	169.0	87.9	73.6	66.6	62.4	59.6	57.5	56.0
260.0	169.0	85.0	69.3	61.4	56.6	53.3	50.9	49.1	260.0	169.0	87.9	73.6	66.6	62.4	59.6	57.5	56.0	280.0	180.8	91.8	76.5	68.9	64.4	61.3	59.0	57.3
280.0	180.8	89.1	72.4	63.9	58.7	55.1	52.5	50.6	280.0	180.8	91.8	76.5	68.9	64.4	61.3	59.0	57.3	300.0	191.9	95.4	79.2	71.2	66.2	62.9	60.5	58.6
300.0	191.9	92.9	75.4	66.4	60.8	57.0	54.1	52.0	300.0	191.9	95.4	79.2	71.2	66.2	62.9	60.5	58.6	320.0	202.5	98.8	81.8	73.3	68.1	64.5	61.9	59.9
320.0	202.5	96.5	78.2	68.7	62.8	58.7	55.7	53.4	320.0	202.5	98.8	81.8	73.3	68.1	64.5	61.9	59.9	340.0	212.6	102.0	84.3	75.4	69.8	66.0	63.2	61.1
340.0	212.6	99.8	80.8	71.0	64.8	60.4	57.2	54.8	340.0	212.6	102.0	84.3	75.4	69.8	66.0	63.2	61.1	360.0	222.3	105.0	86.7	77.3	71.5	67.5	64.5	62.3
360.0	222.3	103.0	83.4	73.1	66.6	62.1	58.7	56.1	360.0	222.3	105.0	86.7	77.3	71.5	67.5	64.5	62.3	380.0	231.6	107.9	88.9	79.2	73.2	68.9	65.8	63.4
380.0	231.6	106.0	85.8	75.2	68.4	63.7	60.2	57.4	380.0	231.6	107.9	88.9	79.2	73.2	68.9	65.8	63.4	400.0	240.5	110.6	91.1	81.1	74.7	70.3	67.1	64.6
400.0	240.5	108.8	88.1	77.2	70.2	65.3	61.6	58.7	400.0	240.5	110.6	91.1	81.1	74.7	70.3	67.1	64.6	420.0	249.1	113.2	93.2	82.8	76.3	71.7	68.3	65.7
420.0	249.1	111.5	90.3	79.1	71.9	66.8	63.0	60.0	420.0	249.1	113.2	93.2	82.8	76.3	71.7	68.3	65.7	440.0	257.4	115.7	95.2	84.6	77.8	73.1	69.5	66.8
440.0	257.4	114.0	92.4	80.9	73.5	68.2	64.3	61.2	440.0	257.4	115.7	95.2	84.6	77.8	73.1	69.5	66.8	460.0	265.4	118.0	97.1	86.2	79.2	74.4	70.7	67.9
460.0	265.4	116.4	94.5	82.7	75.1	69.7	65.6	62.4	460.0	265.4	118.0	97.1	86.2	79.2	74.4	70.7	67.9									

  

DEWPOINT TEMPERATURE = R = 35.0 AIR TEMPERATURE = T = 45.0													DEWPOINT TEMPERATURE = R = 45.0 AIR TEMPERATURE = T = 55.0													
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	29.5	33.9	35.8	36.8	37.5	37.9	38.2	80.0	8.5	36.6	42.0	44.2	45.4	46.2	46.7	47.1	100.0	35.3	44.9	46.8	47.6	48.0	48.3	48.5	48.6
100.0	35.3	38.6	39.3	39.6	39.7	39.9	39.9	40.0	100.0	35.3	44.9	46.8	47.6	48.0	48.3	48.5	48.6	120.0	58.5	52.5	51.3	50.8	50.5	50.3	50.2	50.1
120.0	58.5	46.8	44.3	43.2	42.6	42.2	41.9	41.7	120.0	58.5	52.5	51.3	50.8	50.5	50.3	50.2	50.1	140.0	78.8	59.3	55.5	53.8	52.9	52.3	51.9	51.6
140.0	78.8	54.2	49.0	46.6	45.3	44.4	43.8	43.4	140.0	78.8	59.3	55.5	53.8	52.9	52.3	51.9	51.6	160.0	97.1	65.5	59.4	56.7	55.2	54.2	53.5	53.0
160.0	97.1	60.8	53.3	49.9	47.9	46.6	45.7	45.0	160.0	97.1	65.5	59.4	56.7	55.2	54.2	53.5	53.0	180.0	113.8	71.1	63.1	59.5	57.4	56.0	55.1	54.4
180.0	113.8	66.9	57.4	53.0	50.4	48.7	47.5	46.6	180.0	113.8	71.1	63.1	59.5	57.4	56.0	55.1	54.4	200.0	129.1	76.2	66.6	62.1	59.5	57.8	56.6	55.7
200.0	129.1	72.4	61.2	55.9	52.8	50.7	49.2	48.1	200.0	129.1	76.2	66.6	62.1	59.5	57.8	56.6	55.7	220.0	143.3	81.0	69.9	64.6	61.6	59.5	58.1	57.0
220.0	143.3	77.5	64.8	58.7	55.1	52.7	50.9	49.6	220.0	143.3	81.0	69.9	64.6	61.6	59.5	58.1	57.0	240.0	156.5	85.3	72.9	67.0	63.5	61.2	59.6	58.3
240.0	156.5	82.1	68.2	61.4	57.3	54.6	52.6	51.1	240.0	156.5	85.3	72.9	67.0	63.5	61.2	59.6	58.3	260.0	169.0	89.4	75.9	69.3	65.4	62.8	61.0	59.6
260.0	169.0	86.4	71.4	64.0	59.4	56.4	54.2	52.5	260.0	169.0	89.4	75.9	69.3	65.4	62.8	61.0	59.6	280.0	180.8	93.2	78.6	71.6	67.3	64.4	60.8	58.3
280.0	180.8	90.4	74.4	66.7	63.5	59.9	57.3	55.3	280.0	180.8	93.2	78.6	71.6	67.3	64.4	60.8	58.3	300.0	191.9	96.7	81.3	73.7	69.1	66.0	63.7	62.0
300.0	191.9	94.1	77.3	68.7	63.5	59.9	57.3	55.3	300.0	191.9	96.7	81.3	73.7	69.1	66.0	63.7	62.0	320.0	202.5	100.1	83.8	75.7	70.8	67.4	65.0	63.2
320.0	202.5	97.6	80.0	71.0	65.4	61.6	58.8	56.8	320.0	202.5	100.1	83.8	75.7	70.8	67.4	65.0	63.2	340.0	212.6	103.2	86.2	77.7	72.5	68.9	66.3	64.3
340.0	212.6	100.9	82.5	73.1	67.2	63.2	60.2	57.9	340.0	212.6	103.2	86.2	77.7	72.5	68.9	66.3	64.3	360.0	222.3	104.0	85.0	75.2	69.0	64.8	61.6	59.2
360.0	222.3	104.0	85.0	75.2	69.0	64.8	61.6	59.2	360.0	222.3	104.0	85.0	75.2	69.0	64.8	61.6	59.2	380.0	231.6	105.9	87.3	77.2	70.8	66.3	63.0	60.4
380.0	231.6	106.9	87.3	77.2	70.8	66.3	63.0	60.4	380.0	231.6	106.9	87.3	77.2	70.8	66.3	63.0	60.4	400.0	240.5	109.7	89.6	79.1	72.4	67.8	64.3	61.6
400.0	240.5	109.7	89.6	79.1	72.4	67.8	64.3	61.6	400.0	240.5	109.7	89.6	79.1	72.4	67.8	64.3	61.6	420.0	249.1	112.3	91.7	80.9	74.0	69.2	65.6	62.8
420.0	249.1	112.3	91.7	80.9	74.0	69.2	65.6	62.8	420.0	249.1	112.3	91.7	80.9	74.0	69.2	65.6	62.8	440.0	257.4	114.8	93.8	82.7	75.6	70.6	66.9	64.0
440.0	257.4	114.8	93.8	82.7	75.6	70.6	66.9	64.0	440.0	257.4	114.8	93.8	82.7	75.6	70.6	66.9	64.0	460.0	265.4	117.2	95.8	84.4	77.1	72.0	68.1	65.1
460.0	265.4	117.2	95.8	84.4	77.1	72.0	68.1	65.1	460.0	265.4	117.2	95.8	84.4	77.1	72.0	68.1	65.1									

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 60.0 AIR TEMPERATURE = T = 70.0										DEWPOINT TEMPERATURE = R = 50.0 AIR TEMPERATURE = T = 60.0									
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	48.3	54.9	57.5	58.9	59.8	60.4	60.8		80.0	8.5	40.3	46.2	48.6	49.9	50.7	51.2	51.6	
100.0	35.3	55.5	58.9	60.3	61.0	61.4	61.8	62.0		100.0	35.3	48.3	50.7	51.7	52.3	52.6	52.9	53.0	
120.0	58.5	62.0	62.6	62.8	63.0	63.1	63.1	63.2		120.0	58.5	55.5	54.9	54.7	54.6	54.5	54.4	54.4	
140.0	78.8	67.9	66.1	65.3	64.9	64.6	64.4	64.3		140.0	78.8	62.0	58.9	57.6	56.8	56.3	56.0	55.8	
160.0	97.1	73.3	68.4	67.7	66.7	66.5	65.7	65.4		160.0	97.1	67.9	62.6	60.3	59.0	58.1	57.5	57.1	
180.0	113.8	78.2	72.5	69.9	68.5	67.6	67.0	66.5		180.0	113.8	73.4	66.1	62.9	61.0	59.8	59.0	58.3	
200.0	129.1	82.8	75.4	72.1	70.2	69.0	68.2	67.6		200.0	129.1	78.3	69.4	65.3	63.0	61.5	60.4	59.6	
220.0	143.3	87.0	78.2	74.2	71.9	70.4	69.4	68.6		220.0	143.3	82.9	72.5	67.7	64.9	63.1	61.8	60.8	
240.0	156.5	91.0	80.8	76.2	73.5	71.8	70.6	69.7		240.0	156.5	87.1	75.5	70.0	66.8	64.7	63.2	62.0	
260.0	169.0	94.6	83.3	78.1	75.1	73.1	71.7	70.7		260.0	169.0	91.0	78.2	72.2	68.6	66.2	64.5	63.2	
280.0	180.8	98.1	85.7	80.0	76.6	74.4	72.8	71.7		280.0	180.8	94.7	80.9	74.3	70.3	67.7	65.8	64.3	
300.0	191.9	101.3	88.0	81.8	78.1	75.7	73.9	72.6		300.0	191.9	98.2	83.4	76.3	72.0	69.1	67.0	65.5	
320.0	202.5	104.4	90.2	83.5	79.6	76.9	75.0	73.6		320.0	202.5	101.4	85.8	78.2	73.6	70.5	68.3	66.6	
340.0	212.6	107.3	92.3	85.2	81.0	78.1	76.1	74.5		340.0	212.6	104.5	88.1	80.1	75.2	71.9	69.5	67.6	
360.0	222.3	110.0	94.4	86.8	82.3	79.3	77.1	75.4		360.0	222.3	107.4	90.3	81.9	76.7	73.2	70.6	68.7	
380.0	231.6	112.6	96.3	88.4	83.6	80.4	78.1	76.3		380.0	231.6	110.1	92.4	83.6	78.2	74.5	71.8	69.7	
400.0	240.5	115.1	98.2	89.9	84.9	81.5	79.1	77.2		400.0	240.5	112.7	94.5	85.3	79.6	75.8	72.9	70.7	
420.0	249.1	117.5	100.0	91.4	86.2	82.6	80.1	78.1		420.0	249.1	115.2	96.4	86.9	81.0	77.0	74.0	71.7	
440.0	257.4	119.8	101.7	92.9	87.4	83.7	81.0	79.0		440.0	257.4	117.6	98.3	88.5	82.4	78.2	75.1	72.7	
460.0	265.4	122.0	103.4	94.3	88.6	84.8	81.9	79.8		460.0	265.4	119.9	100.1	90.0	83.7	79.4	76.1	73.7	

DEWPOINT TEMPERATURE = R = 55.0 AIR TEMPERATURE = T = 65.0									
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	44.2	50.5	53.0	54.4	55.2	55.8	56.2	
100.0	35.3	51.8	54.7	55.9	56.6	57.0	57.3	57.5	
120.0	58.5	58.7	58.7	58.7	58.7	58.7	58.7	58.8	
140.0	78.8	64.9	62.4	61.4	60.8	60.4	60.2	60.0	
160.0	97.1	70.6	65.9	63.9	62.8	62.1	61.6	61.2	
180.0	113.8	75.7	69.2	66.4	64.7	63.7	62.9	62.4	
200.0	129.1	80.5	72.3	68.7	66.6	65.2	64.3	63.6	
220.0	143.3	84.9	75.3	70.9	68.4	66.7	65.6	64.7	
240.0	156.5	89.0	78.1	73.0	70.1	68.2	66.8	65.8	
260.0	169.0	92.8	80.7	75.1	71.8	69.6	68.1	66.9	
280.0	180.8	96.4	83.3	77.1	73.4	71.0	69.3	68.0	
300.0	191.9	99.7	85.7	79.0	75.0	72.3	70.4	69.0	
320.0	202.5	102.8	88.0	80.8	76.5	73.7	71.6	70.0	
340.0	212.6	105.8	90.2	82.6	78.0	74.9	72.7	71.0	
360.0	222.3	108.6	92.3	84.3	79.5	76.2	73.8	72.0	
380.0	231.6	111.3	94.3	86.0	80.9	77.4	74.9	73.0	
400.0	240.5	113.8	96.3	87.6	82.2	78.6	76.0	73.9	
420.0	249.1	116.3	98.1	89.1	83.6	79.8	77.0	74.9	
440.0	257.4	118.6	100.0	90.6	84.9	80.9	78.0	75.8	
460.0	265.4	120.9	101.7	92.1	86.1	82.0	79.0	76.7	

DEWPOINT TEMPERATURE = R = 65.0 AIR TEMPERATURE = T = 75.0									
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	52.6	59.5	62.2	63.6	64.4	65.0	65.5	
100.0	35.3	59.3	63.1	64.6	65.5	66.0	66.3	66.5	
120.0	58.5	66.6	67.0	67.3	67.4	67.5	67.6	67.6	
140.0	78.8	71.1	69.8	69.3	69.0	68.9	68.7	68.7	
160.0	97.1	76.2	72.9	71.5	70.8	70.3	69.9	69.7	
180.0	113.8	80.9	75.8	73.6	72.4	71.6	71.1	70.7	
200.0	129.1	85.3	78.6	75.8	74.0	73.0	72.2	71.7	
220.0	143.3	89.3	81.2	77.8	75.6	74.3	73.3	72.7	
240.0	156.5	93.1	83.7	79.5	77.1	75.5	74.4	73.6	
260.0	169.0	96.6	86.1	81.3	78.5	76.7	75.5	74.5	
280.0	180.8	99.9	88.3	83.0	80.0	77.9	76.5	75.5	
300.0	191.9	103.1	90.5	84.7	81.4	79.1	77.5	76.4	
320.0	202.5	106.0	92.6	86.4	82.7	80.3	78.5	77.2	
340.0	212.6	108.8	94.6	88.0	84.0	81.4	79.5	78.1	
360.0	222.3	111.5	96.6	89.5	85.3	82.5	80.5	79.0	
380.0	231.6	114.0	98.4	91.0	86.5	83.6	81.4	79.8	
400.0	240.5	116.5	100.2	92.4	87.8	84.6	82.3	80.6	
420.0	249.1	118.6	102.0	93.8	89.9	86.6	84.2	81.4	
440.0	257.4	121.0	103.7	95.2	90.1	86.8	84.1	82.2	
460.0	265.4	123.1	105.3	96.6	91.2	87.6	85.0	83.0	

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 80.0 AIR TEMPERATURE = T = 90.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	66.3	73.7	76.4	77.8	78.7	79.3	79.7		
100.0	35.3	71.8	76.5	78.3	79.3	79.8	80.2	80.5		
120.0	58.5	76.8	79.2	80.2	80.7	81.0	81.2	81.3		
140.0	78.8	81.5	81.8	81.9	82.0	82.1	82.1	82.1		
160.0	97.1	85.8	84.3	83.7	83.3	83.1	83.0	82.9		
180.0	113.8	89.8	86.6	85.3	84.6	84.2	83.9	83.7		
200.0	129.1	93.5	88.9	86.9	85.9	85.2	84.8	84.4		
220.0	143.3	97.0	91.0	88.5	87.1	86.2	85.6	85.2		
240.0	156.5	100.3	93.1	90.0	88.3	87.2	86.5	85.9		
260.0	169.0	103.4	95.1	91.5	89.5	88.2	87.3	86.6		
280.0	180.8	106.3	97.0	92.9	90.6	89.1	88.1	87.4		
300.0	191.9	109.1	98.8	94.3	91.7	90.1	88.9	88.1		
320.0	202.5	111.7	100.6	95.7	92.8	91.0	89.7	88.7		
340.0	212.6	114.3	102.3	97.0	93.9	91.9	90.5	89.4		
360.0	222.5	116.7	104.0	98.2	94.9	92.8	91.2	90.1		
380.0	231.6	119.0	105.6	99.5	96.0	93.6	92.0	90.8		
400.0	240.5	121.2	107.1	100.7	97.0	94.5	92.7	91.4		
420.0	249.1	123.3	108.7	101.9	97.9	95.3	93.5	92.1		
440.0	257.4	125.3	110.1	103.1	98.9	96.2	94.2	92.7		
460.0	265.4	127.3	111.6	104.2	99.9	97.0	94.9	93.3		

  

DEWPOINT TEMPERATURE = R = 85.0 AIR TEMPERATURE = T = 95.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	71.2	78.6	81.3	82.7	83.5	84.1	84.5		
100.0	35.3	75.2	81.2	83.0	84.0	84.6	85.0	85.3		
120.0	58.5	80.9	83.7	84.7	85.3	85.6	85.8	86.0		
140.0	78.8	85.2	86.0	86.3	86.5	86.6	86.7	86.7		
160.0	97.1	89.3	88.3	87.9	87.7	87.6	87.5	87.4		
180.0	113.8	93.0	90.5	89.4	88.9	88.5	88.3	88.1		
200.0	129.1	96.5	92.5	90.9	90.0	89.5	89.1	88.8		
220.0	143.3	99.8	94.6	92.4	91.2	90.4	89.9	89.5		
240.0	156.5	103.0	96.5	93.8	92.3	91.3	90.7	90.2		
260.0	169.0	105.9	98.3	95.1	93.3	92.2	91.4	90.8		
280.0	180.8	108.7	100.1	96.5	94.4	93.1	92.2	91.5		
300.0	191.9	111.4	101.9	97.7	95.4	93.9	92.9	92.1		
320.0	202.5	113.9	103.5	99.0	96.4	94.8	93.6	92.8		
340.0	212.6	116.3	105.2	100.2	97.4	95.6	94.3	93.4		
360.0	222.5	118.6	106.7	101.4	98.4	96.4	95.1	94.0		
380.0	231.6	120.9	108.2	102.6	99.4	97.2	95.7	94.6		
400.0	240.5	123.0	109.7	103.7	100.3	98.0	96.4	95.2		
420.0	249.1	125.1	111.2	104.9	101.2	98.8	97.1	95.8		
440.0	257.4	127.1	112.6	106.0	102.1	99.6	97.8	96.4		
460.0	265.4	128.9	113.9	107.0	103.0	100.3	98.4	97.0		

  

DEWPOINT TEMPERATURE = R = 75.0 AIR TEMPERATURE = T = 85.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	61.6	68.9	71.6	73.0	73.9	74.5	74.9		
100.0	35.3	67.5	72.0	73.7	74.6	75.2	75.5	75.8		
120.0	58.5	72.9	74.9	75.7	76.1	76.4	76.6	76.7		
140.0	78.8	77.8	77.7	77.6	77.6	77.6	77.6	77.6		
160.0	97.1	82.4	80.4	79.5	79.1	78.8	78.6	78.4		
180.0	113.8	86.7	82.9	81.3	80.5	79.9	79.6	79.3		
200.0	129.1	90.6	85.3	83.1	81.8	81.0	80.5	80.1		
220.0	143.3	94.3	87.6	84.8	83.2	82.1	81.4	80.9		
240.0	156.5	97.7	89.8	86.4	84.5	83.2	82.4	81.7		
260.0	169.0	101.0	91.9	88.0	85.7	84.3	83.3	82.5		
280.0	180.8	104.0	94.0	89.5	87.0	85.3	84.2	83.3		
300.0	191.9	106.9	95.9	91.0	88.2	86.3	85.0	84.1		
320.0	202.5	109.7	97.8	92.4	89.3	87.3	85.9	84.8		
340.0	212.6	112.3	99.6	93.8	90.5	88.3	86.7	85.6		
360.0	222.5	114.8	101.4	95.2	91.6	89.2	87.5	86.3		
380.0	231.6	117.2	103.1	96.5	92.7	90.2	88.4	87.0		
400.0	240.5	119.5	104.7	97.8	93.8	91.1	89.2	87.7		
420.0	249.1	121.7	106.3	99.1	94.8	92.0	89.9	88.4		
440.0	257.4	123.8	107.8	100.3	95.8	92.9	90.7	89.1		
460.0	265.4	125.8	109.3	101.5	96.9	93.7	91.5	89.8		

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 90.0 AIR TEMPERATURE = T = 100.0											
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>m</sub>	W=0	W=5
80.0	8.5	76.1	83.6	86.2	87.6	88.4	89.0	89.4	80.0	8.5	24.0
100.0	35.3	80.8	85.9	87.8	88.8	89.4	89.8	90.1	100.0	35.3	33.6
120.0	58.5	85.1	88.2	89.3	89.9	90.3	90.5	90.7	120.0	58.5	42.3
140.0	78.8	89.2	90.4	90.8	91.0	91.2	91.3	91.4	140.0	78.8	50.1
160.0	97.1	92.9	92.4	92.3	92.2	92.1	92.0	92.0	160.0	97.1	57.2
180.0	113.8	96.4	94.4	93.7	93.2	93.0	92.8	92.7	180.0	113.8	63.6
200.0	129.1	98.7	96.4	95.0	94.3	93.8	93.5	93.3	200.0	129.1	69.4
220.0	143.3	102.9	98.2	96.3	95.3	94.7	94.2	93.9	220.0	143.3	74.7
240.0	156.5	105.8	100.0	97.6	96.3	95.5	94.9	94.5	240.0	156.5	79.6
260.0	169.0	108.6	101.7	98.9	97.3	96.3	95.6	95.1	260.0	169.0	84.1
280.0	180.8	111.3	103.4	100.1	98.3	97.1	96.3	95.7	280.0	180.8	88.3
300.0	191.9	113.8	105.0	101.3	99.2	97.9	97.0	96.3	300.0	191.9	92.1
320.0	202.5	116.2	106.6	102.5	100.2	98.7	97.7	96.9	320.0	202.5	95.7
340.0	212.6	118.6	108.1	103.6	101.1	99.5	98.3	97.5	340.0	212.6	99.1
360.0	222.3	120.8	109.6	104.8	102.0	100.2	99.0	98.0	360.0	222.3	102.3
380.0	231.6	122.9	111.1	105.8	102.9	100.9	99.6	98.6	380.0	231.6	105.3
400.0	240.5	125.0	112.5	106.9	103.7	101.7	100.2	99.2	400.0	240.5	108.2
420.0	249.1	126.9	113.6	108.0	104.6	102.4	100.9	99.7	420.0	249.1	110.9
440.0	257.4	128.8	115.1	109.0	105.4	103.1	101.5	100.2	440.0	257.4	113.5
460.0	265.4	130.7	116.4	110.0	106.3	103.8	102.1	100.8	460.0	265.4	115.9

DEWPOINT TEMPERATURE = R = 20.0  
AIR TEMPERATURE = T = 40.0

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 24.0 27.4 28.9 29.7 30.2 30.6 30.9  
35.3 33.6 33.2 33.1 33.0 32.9 32.9 32.8  
58.5 42.3 38.7 37.0 36.1 35.5 35.0 34.7  
78.8 50.1 43.7 40.8 39.1 37.9 37.2 36.6  
97.1 57.2 48.5 44.3 41.9 40.3 39.2 38.4  
113.8 63.6 52.9 47.7 44.7 42.7 41.2 40.1  
129.1 69.4 57.0 50.9 47.3 44.9 43.2 41.8  
143.3 74.7 60.8 54.0 49.8 47.0 45.0 43.5  
156.5 79.6 64.5 56.9 52.3 49.1 46.9 45.1  
169.0 84.1 67.9 59.7 54.6 51.1 48.6 46.7  
180.8 88.3 71.1 62.3 56.8 53.1 50.4 48.3  
191.9 92.1 74.1 64.8 59.0 55.0 52.0 49.8  
202.5 95.7 77.0 67.2 61.1 56.8 53.7 51.2  
212.6 99.1 79.7 69.5 63.1 58.6 55.2 52.7  
222.3 102.3 82.3 71.7 65.0 60.3 56.8 54.1  
231.6 105.3 84.8 73.9 66.9 62.0 58.3 55.4  
240.5 108.2 87.1 75.9 68.7 63.6 59.7 56.8  
249.1 110.9 89.4 77.9 70.4 65.1 61.2 58.1  
257.4 113.5 91.5 79.8 72.1 66.7 62.5 59.3  
265.4 115.9 93.6 81.6 73.7 68.1 63.9 60.6

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 27.0 30.9 32.6 33.6 34.2 34.6 34.9

35.3 36.3 36.5 36.6 36.7 36.7 36.7 36.7

58.5 44.7 41.7 40.4 39.6 39.1 38.8 38.5

78.8 52.3 46.6 43.9 42.4 41.5 40.8 40.3

97.1 59.2 51.1 47.3 45.2 43.7 42.7 42.0

113.8 65.4 55.3 50.6 47.8 45.9 44.6 43.6

129.1 71.0 59.3 53.6 50.3 48.0 46.4 45.2

143.3 76.2 63.0 56.6 52.7 50.1 48.2 46.8

156.5 80.9 66.5 59.3 55.0 52.1 50.0 48.4

169.0 85.3 69.8 62.0 57.2 54.0 51.6 49.9

180.8 89.4 72.9 64.5 59.4 55.8 53.3 51.3

191.9 93.2 75.8 66.9 61.4 57.6 54.9 52.8

202.5 96.7 78.6 69.3 63.4 59.4 56.4 54.2

212.6 100.1 81.2 71.5 65.3 61.1 57.9 55.5

222.3 103.2 83.7 73.6 67.2 62.7 58.4 56.8

231.6 106.2 86.1 75.6 68.0 64.3 60.8 58.1

240.5 109.0 88.4 77.8 70.7 65.8 62.2 59.4

249.1 111.7 90.6 79.5 72.4 67.3 63.6 60.6

257.4 114.2 92.7 81.3 74.0 68.8 64.9 61.8

265.4 116.6 94.8 83.1 75.6 70.2 66.2 63.0

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 27.0 30.9 32.6 33.6 34.2 34.6 34.9

35.3 36.3 36.5 36.6 36.7 36.7 36.7 36.7

58.5 44.7 41.7 40.4 39.6 39.1 38.8 38.5

78.8 52.3 46.6 43.9 42.4 41.5 40.8 40.3

97.1 59.2 51.1 47.3 45.2 43.7 42.7 42.0

113.8 65.4 55.3 50.6 47.8 45.9 44.6 43.6

129.1 71.0 59.3 53.6 50.3 48.0 46.4 45.2

143.3 76.2 63.0 56.6 52.7 50.1 48.2 46.8

156.5 80.9 66.5 59.3 55.0 52.1 50.0 48.4

169.0 85.3 69.8 62.0 57.2 54.0 51.6 49.9

180.8 89.4 72.9 64.5 59.4 55.8 53.3 51.3

191.9 93.2 75.8 66.9 61.4 57.6 54.9 52.8

202.5 96.7 78.6 69.3 63.4 59.4 56.4 54.2

212.6 100.1 81.2 71.5 65.3 61.1 57.9 55.5

222.3 103.2 83.7 73.6 67.2 62.7 58.4 56.8

231.6 106.2 86.1 75.6 68.0 64.3 60.8 58.1

240.5 109.0 88.4 77.8 70.7 65.8 62.2 59.4

249.1 111.7 90.6 79.5 72.4 67.3 63.6 60.6

257.4 114.2 92.7 81.3 74.0 68.8 64.9 61.8

265.4 116.6 94.8 83.1 75.6 70.2 66.2 63.0

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 27.0 30.9 32.6 33.6 34.2 34.6 34.9

35.3 36.3 36.5 36.6 36.7 36.7 36.7 36.7

58.5 44.7 41.7 40.4 39.6 39.1 38.8 38.5

78.8 52.3 46.6 43.9 42.4 41.5 40.8 40.3

97.1 59.2 51.1 47.3 45.2 43.7 42.7 42.0

113.8 65.4 55.3 50.6 47.8 45.9 44.6 43.6

129.1 71.0 59.3 53.6 50.3 48.0 46.4 45.2

143.3 76.2 63.0 56.6 52.7 50.1 48.2 46.8

156.5 80.9 66.5 59.3 55.0 52.1 50.0 48.4

169.0 85.3 69.8 62.0 57.2 54.0 51.6 49.9

180.8 89.4 72.9 64.5 59.4 55.8 53.3 51.3

191.9 93.2 75.8 66.9 61.4 57.6 54.9 52.8

202.5 96.7 78.6 69.3 63.4 59.4 56.4 54.2

212.6 100.1 81.2 71.5 65.3 61.1 57.9 55.5

222.3 103.2 83.7 73.6 67.2 62.7 58.4 56.8

231.6 106.2 86.1 75.6 68.0 64.3 60.8 58.1

240.5 109.0 88.4 77.8 70.7 65.8 62.2 59.4

249.1 111.7 90.6 79.5 72.4 67.3 63.6 60.6

257.4 114.2 92.7 81.3 74.0 68.8 64.9 61.8

265.4 116.6 94.8 83.1 75.6 70.2 66.2 63.0

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 27.0 30.9 32.6 33.6 34.2 34.6 34.9

35.3 36.3 36.5 36.6 36.7 36.7 36.7 36.7

58.5 44.7 41.7 40.4 39.6 39.1 38.8 38.5

78.8 52.3 46.6 43.9 42.4 41.5 40.8 40.3

97.1 59.2 51.1 47.3 45.2 43.7 42.7 42.0

113.8 65.4 55.3 50.6 47.8 45.9 44.6 43.6

129.1 71.0 59.3 53.6 50.3 48.0 46.4 45.2

143.3 76.2 63.0 56.6 52.7 50.1 48.2 46.8

156.5 80.9 66.5 59.3 55.0 52.1 50.0 48.4

169.0 85.3 69.8 62.0 57.2 54.0 51.6 49.9

180.8 89.4 72.9 64.5 59.4 55.8 53.3 51.3

191.9 93.2 75.8 66.9 61.4 57.6 54.9 52.8

202.5 96.7 78.6 69.3 63.4 59.4 56.4 54.2

212.6 100.1 81.2 71.5 65.3 61.1 57.9 55.5

222.3 103.2 83.7 73.6 67.2 62.7 58.4 56.8

231.6 106.2 86.1 75.6 68.0 64.3 60.8 58.1

240.5 109.0 88.4 77.8 70.7 65.8 62.2 59.4

249.1 111.7 90.6 79.5 72.4 67.3 63.6 60.6

257.4 114.2 92.7 81.3 74.0 68.8 64.9 61.8

265.4 116.6 94.8 83.1 75.6 70.2 66.2 63.0

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 27.0 30.9 32.6 33.6 34.2 34.6 34.9

35.3 36.3 36.5 36.6 36.7 36.7 36.7 36.7

58.5 44.7 41.7 40.4 39.6 39.1 38.8 38.5

78.8 52.3 46.6 43.9 42.4 41.5 40.8 40.3

97.1 59.2 51.1 47.3 45.2 43.7 42.7 42.0

113.8 65.4 55.3 50.6 47.8 45.9 44.6 43.6

129.1 71.0 59.3 53.6 50.3 48.0 46.4 45.2

143.3 76.2 63.0 56.6 52.7 50.1 48.2 46.8

156.5 80.9 66.5 59.3 55.0 52.1 50.0 48.4

169.0 85.3 69.8 62.0 57.2 54.0 51.6 49.9

180.8 89.4 72.9 64.5 59.4 55.8 53.3 51.3

191.9 93.2 75.8 66.9 61.4 57.6 54.9 52.8

202.5 96.7 78.6 69.3 63.4 59.4 56.4 54.2

212.6 100.1 81.2 71.5 65.3 61.1 57.9 55.5

222.3 103.2 83.7 73.6 67.2 62.7 58.4 56.8

231.6 106.2 86.1 75.6 68.0 64.3 60.8 58.1

240.5 109.0 88.4 77.8 70.7 65.8 62.2 59.4

249.1 111.7 90.6 79.5 72.4 67.3 63.6 60.6

257.4 114.2 92.7 81.3 74.0 68.8 64.9 61.8

265.4 116.6 94.8 83.1 75.6 70.2 66.2 63.0

Q<sub>m</sub>

W=0 W=5 W=10 W=15 W=20 W=25 W=30 W=35

8.5 27.0 30.9

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 40.0 AIR TEMPERATURE = T = 60.0											
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	W=40	W=45	W=50
80.0	8.5	30.0	34.5	36.4	37.4	38.1	38.6	38.9	39.0	39.1	39.2
100.0	35.3	39.1	39.8	40.2	40.4	40.5	40.6	40.6	40.7	40.7	40.8
120.0	58.5	47.2	44.8	43.8	43.2	42.8	42.5	42.3	42.2	42.1	42.0
140.0	78.8	54.5	49.4	47.2	45.9	45.0	44.4	43.6	43.1	42.9	42.7
160.0	97.1	61.2	53.8	50.4	48.4	47.2	46.3	45.6	45.1	44.9	44.7
180.0	113.8	67.2	57.8	53.5	50.9	49.2	48.0	47.1	46.5	46.2	46.0
200.0	129.1	72.7	61.6	56.4	53.3	51.2	49.8	48.7	47.9	47.4	47.1
220.0	143.3	77.7	65.2	59.2	55.6	53.2	51.5	50.2	49.3	48.7	48.3
240.0	156.5	82.3	68.8	61.8	57.8	55.1	53.1	51.6	50.5	49.7	49.1
260.0	169.0	86.6	71.7	64.4	59.9	56.9	54.7	53.0	51.7	50.7	50.0
280.0	180.8	90.6	74.7	66.8	61.9	58.6	56.2	54.4	53.0	51.9	51.1
300.0	191.9	94.3	77.5	69.1	63.9	60.3	57.7	55.8	54.4	53.2	52.3
320.0	202.5	97.8	80.2	71.3	65.8	62.0	59.2	57.1	55.6	54.3	53.3
340.0	212.6	101.1	82.8	73.5	67.6	63.6	60.6	58.4	56.8	55.4	54.3
360.0	222.3	104.1	85.2	75.5	69.4	65.2	62.0	59.6	57.9	56.4	55.3
380.0	231.6	107.0	87.6	77.5	71.1	66.7	63.4	60.9	59.1	57.5	56.3
400.0	240.5	109.8	89.8	79.4	72.8	68.2	64.7	62.1	60.2	58.5	57.2
420.0	249.1	112.4	91.9	81.2	74.4	69.6	66.0	63.3	61.3	59.5	58.1
440.0	257.4	114.9	94.0	83.0	75.9	71.0	67.3	64.4	62.3	60.4	58.9
460.0	265.4	117.3	96.0	84.7	77.4	72.3	68.5	65.5	63.3	61.3	59.7

DEWPOINT TEMPERATURE = R = 35.0  
AIR TEMPERATURE = T = 55.0

Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	33.2	38.2	40.2	41.4	42.1	42.6	42.9
100.0	35.3	41.9	43.2	43.8	44.1	44.3	44.5	44.6
120.0	58.5	49.6	48.0	47.2	46.8	46.5	46.3	46.2
140.0	78.8	56.8	52.4	50.4	49.3	48.6	48.1	47.7
160.0	97.1	63.2	56.5	53.5	51.8	50.6	49.8	49.2
180.0	113.8	69.1	60.4	56.4	54.1	52.6	51.5	50.7
200.0	129.1	74.4	64.0	59.2	56.3	54.5	53.1	52.1
220.0	143.3	79.3	67.5	61.8	58.5	56.3	54.7	53.5
240.0	156.5	83.8	70.7	64.4	60.6	58.1	56.3	54.9
260.0	169.0	88.0	73.7	66.8	62.6	59.8	57.8	56.3
280.0	180.8	91.9	76.6	69.1	64.6	61.5	59.2	57.6
300.0	191.9	95.5	79.4	71.3	66.4	63.1	60.7	58.8
320.0	202.5	98.9	82.0	73.5	68.2	64.7	62.1	60.1
340.0	212.6	102.1	84.4	75.5	70.0	66.2	63.4	61.3
360.0	222.3	105.1	86.8	77.5	71.7	67.7	64.7	62.5
380.0	231.6	108.0	89.1	79.4	73.3	69.1	66.0	63.7
400.0	240.5	110.7	91.2	81.2	74.9	70.5	67.3	64.8
420.0	249.1	113.3	93.3	83.0	76.4	71.9	68.5	65.9
440.0	257.4	115.7	95.3	84.7	77.9	73.2	69.7	67.0
460.0	265.4	118.1	97.2	86.3	79.4	74.5	70.9	68.1

DEWPOINT TEMPERATURE = R = 45.0  
AIR TEMPERATURE = T = 65.0

Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	40.0	45.8	48.2	49.4	50.2	50.8	51.2
100.0	35.3	48.0	50.3	51.3	51.9	52.2	52.4	52.6
120.0	58.5	55.2	54.6	54.3	54.2	54.1	54.0	54.0
140.0	78.8	61.8	58.6	57.2	56.4	55.9	55.6	55.4
160.0	97.1	67.7	62.3	59.8	58.6	57.7	57.1	56.7
180.0	113.8	73.1	65.8	62.5	60.7	59.5	58.6	58.0
200.0	129.1	78.1	69.1	65.0	62.7	61.1	60.0	59.2
220.0	143.3	82.7	72.3	67.4	64.6	62.8	61.4	60.5
240.0	156.5	86.9	75.2	69.7	66.5	64.3	62.8	61.7
260.0	169.0	90.9	78.0	71.9	68.3	65.9	64.1	62.8
280.0	180.8	94.6	80.7	74.0	70.0	67.4	65.4	64.0
300.0	191.9	98.0	83.2	76.0	71.7	68.8	66.7	65.1
320.0	202.5	101.3	85.6	78.0	73.3	70.2	67.9	66.2
340.0	212.6	104.3	87.9	79.8	74.9	71.6	69.2	67.3
360.0	222.3	107.2	90.1	81.7	76.5	72.9	70.3	68.4
380.0	231.6	110.0	92.3	83.4	77.9	74.2	71.5	69.4
400.0	240.5	112.6	94.3	85.1	79.4	75.5	72.6	70.4
420.0	249.1	115.1	96.2	86.7	80.8	76.7	73.7	71.4
440.0	257.4	117.5	98.1	88.3	82.2	77.9	74.8	72.4
460.0	265.4	119.8	99.9	89.8	83.5	79.1	75.9	73.4

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 50.0 AIR TEMPERATURE = T = 70.0									
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	43.6	49.8	52.3	53.6	54.4	55.0	55.4	
100.0	35.3	51.2	54.0	55.2	55.8	56.2	56.5	56.7	
120.0	58.5	58.1	58.1	58.0	58.0	58.0	58.0	58.0	
140.0	78.8	64.4	61.8	60.7	60.1	59.7	59.5	59.3	
160.0	97.1	70.1	65.4	63.3	62.1	61.4	60.9	60.5	
180.0	113.8	75.3	68.7	65.7	64.1	63.0	62.2	61.7	
200.0	129.1	80.1	71.8	68.1	66.0	64.6	63.6	62.9	
220.0	143.3	84.5	74.8	70.3	67.8	66.1	64.9	64.0	
240.0	156.5	88.7	77.6	72.5	69.5	67.6	66.2	65.1	
260.0	169.0	92.5	80.3	74.6	71.2	69.0	67.4	66.3	
280.0	180.8	96.1	82.8	76.6	72.9	70.4	68.7	67.3	
300.0	191.9	99.4	85.3	78.5	74.5	71.8	69.8	68.4	
320.0	202.5	102.6	87.6	80.4	76.0	73.1	71.0	69.4	
340.0	212.6	105.6	89.8	82.2	77.5	74.4	72.1	70.4	
360.0	222.3	108.4	91.9	83.9	79.0	75.7	73.3	71.4	
380.0	231.6	111.1	94.0	85.5	80.4	76.9	74.4	72.4	
400.0	240.5	113.7	95.9	87.2	81.8	78.1	75.4	73.4	
420.0	249.1	116.1	97.8	88.7	83.1	79.3	76.5	74.3	
440.0	257.4	118.4	99.7	90.3	84.4	80.4	77.5	75.2	
460.0	265.4	120.7	101.4	91.7	85.7	81.5	78.5	76.1	

DEWPOINT TEMPERATURE = R = 55.0 AIR TEMPERATURE = T = 75.0									
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	47.3	53.8	56.4	57.8	58.7	59.2	59.7	
100.0	35.3	54.6	57.9	59.2	59.9	60.3	60.7	60.9	
120.0	58.5	61.2	61.6	61.8	61.9	62.0	62.0	62.1	
140.0	78.8	67.1	65.2	64.3	63.9	63.6	63.4	63.2	
160.0	97.1	72.6	68.5	66.7	65.8	65.1	64.7	64.4	
180.0	113.8	77.6	71.6	69.0	67.6	66.6	66.0	65.5	
200.0	129.1	82.2	74.6	71.3	69.3	68.1	67.2	66.6	
220.0	143.3	86.5	77.4	73.4	71.0	69.5	68.4	67.7	
240.0	156.5	90.5	80.1	75.4	72.7	70.9	69.6	68.7	
260.0	169.0	94.2	82.7	77.4	74.3	72.3	70.8	69.7	
280.0	180.8	97.7	85.1	79.3	75.8	73.6	72.0	70.7	
300.0	191.9	100.9	87.4	81.1	77.3	74.8	73.1	71.7	
320.0	202.5	104.0	89.7	82.9	78.8	76.1	74.2	72.7	
340.0	212.6	106.9	91.8	84.6	80.2	77.3	75.2	73.7	
360.0	222.3	109.7	93.8	86.2	81.6	78.5	76.3	74.6	
380.0	231.6	112.3	95.8	87.8	83.0	79.7	77.3	75.5	
400.0	240.5	114.8	97.7	89.3	84.3	80.8	78.3	76.4	
420.0	249.1	117.2	99.5	90.8	85.5	81.9	79.3	77.3	
440.0	257.4	119.5	101.3	92.3	86.8	83.0	80.3	78.2	
460.0	265.4	121.7	103.0	93.7	88.0	84.1	81.2	79.0	

DEWPOINT TEMPERATURE = R = 60.0 AIR TEMPERATURE = T = 80.0									
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	51.2	58.0	60.7	62.1	63.0	63.6	64.0	
100.0	35.3	58.1	61.8	63.3	64.0	64.5	64.9	65.1	
120.0	58.5	64.4	65.3	65.7	65.9	66.0	66.1	66.2	
140.0	78.8	70.0	68.6	68.0	67.7	67.5	67.4	67.3	
160.0	97.1	75.3	71.8	70.3	69.5	69.0	68.6	68.4	
180.0	113.8	80.0	74.7	72.4	71.2	70.4	69.8	69.4	
200.0	129.1	84.5	77.5	74.5	72.8	71.7	70.9	70.4	
220.0	143.3	88.6	80.2	76.5	74.4	73.0	72.1	71.4	
240.0	156.5	92.4	82.8	78.4	75.9	74.3	73.2	72.4	
260.0	169.0	96.0	85.2	80.3	77.4	75.6	74.3	73.3	
280.0	180.8	99.3	87.5	82.1	78.9	76.8	75.3	74.2	
300.0	191.9	102.5	89.7	83.8	80.3	78.0	76.4	75.2	
320.0	202.5	105.5	91.9	85.5	81.7	79.2	77.4	76.1	
340.0	212.6	108.3	93.9	87.1	83.0	80.3	78.4	77.0	
360.0	222.3	111.0	95.9	89.6	84.3	81.5	79.4	77.8	
380.0	231.6	113.6	97.8	90.2	85.6	82.6	80.4	78.7	
400.0	240.5	116.0	99.6	91.6	86.9	83.6	81.3	79.5	
420.0	249.1	118.4	101.3	93.1	88.1	84.7	82.2	80.4	
440.0	257.4	120.6	103.0	94.5	89.2	85.7	83.1	81.2	
460.0	265.4	122.8	104.7	95.8	90.4	86.7	84.0	82.0	

DEWPOINT TEMPERATURE = R = 65.0 AIR TEMPERATURE = T = 85.0									
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	55.3	61.3	65.0	66.5	67.3	67.9	68.4	
100.0	35.3	61.8	65.8	67.4	68.3	68.8	69.1	69.4	
120.0	58.5	67.7	69.1	69.7	70.0	70.2	70.3	70.4	
140.0	78.8	73.1	72.2	71.9	71.7	71.5	71.5	71.4	
160.0	97.1	78.0	75.2	73.9	73.3	72.9	72.6	72.4	
180.0	113.8	82.6	77.9	76.0	74.9	74.2	73.7	73.3	
200.0	129.1	86.9	80.6	77.9	76.4	75.4	74.8	74.3	
220.0	143.3	90.8	83.1	79.8	77.9	76.7	75.8	75.2	
240.0	156.5	94.5	85.5	81.6	78.3	77.9	76.8	76.1	
260.0	169.0	97.9	87.8	83.3	80.7	79.0	77.8	77.0	
280.0	180.8	101.2	90.0	85.0	82.1	80.2	78.8	78.7	
300.0	191.9	104.2	92.1	86.6	83.4	81.3	79.8	79.5	
320.0	202.5	107.1	94.2	88.2	84.7	82.4	80.8	80.5	
340.0	212.6	109.9	96.1	89.7	86.0	83.5	81.7	80.4	
360.0	222.3	112.5	98.0	91.2	87.2	84.5	82.6	81.2	
380.0	231.6	115.0	99.8	92.7	88.4	85.6	83.5	82.0	
400.0	240.5	117.4	101.6	94.1	89.6	86.6	84.4	82.8	
420.0	249.1	119.6	103.3	95.4	90.7	87.5	85.3	83.5	
440.0	257.4	121.8	104.9	96.7	91.8	88.5	86.1	84.3	
460.0	265.4	123.9	106.5	98.0	92.9	89.5	87.0	85.1	

DEWPOINT TEMPERATURE = R = 70.0 AIR TEMPERATURE = T = 90.0											
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35			
80.0	8.5	59.5	66.8	69.5	70.9	71.8	72.4	72.8			
100.0	35.3	65.6	70.0	71.7	72.6	73.1	73.5	73.8			
120.0	58.5	71.2	73.0	73.8	74.2	74.4	74.6	74.7			
140.0	78.8	78.3	75.9	75.8	75.7	75.6	75.6	75.6			
160.0	97.1	81.0	78.7	77.7	77.2	76.9	76.6	76.5			
180.0	113.9	85.3	81.3	78.6	76.7	75.1	73.7	72.4			
200.0	129.1	89.4	83.8	81.4	80.1	79.2	78.2	77.2			
220.0	147.3	93.1	86.1	83.1	81.5	80.4	79.6	78.1			
240.0	156.5	96.7	88.4	84.8	82.8	81.5	80.6	79.9			
260.0	169.0	100.0	90.6	86.5	84.1	82.6	81.5	80.7			
280.0	180.8	103.1	92.7	88.0	85.4	83.6	82.4	81.5			
300.0	191.9	106.0	94.7	89.6	86.6	84.7	83.3	82.3			
320.0	202.5	108.8	96.6	91.1	87.8	85.7	84.2	83.1			
340.0	212.6	111.5	98.5	92.5	89.0	86.7	85.1	83.9			
360.0	222.3	114.0	100.3	93.9	90.2	87.7	85.9	84.6			
380.0	231.6	116.5	102.0	95.3	91.3	88.7	86.8	85.4			
400.0	240.5	118.8	103.7	96.6	92.4	89.6	87.6	86.1			
420.0	249.1	121.0	105.3	97.9	93.5	90.5	88.4	86.8			
440.0	257.4	123.1	106.9	99.1	94.5	91.4	89.2	87.6			
460.0	265.4	125.2	108.4	100.4	95.6	92.3	90.0	88.3			

DEWPOINT TEMPERATURE = R = 75.0 AIR TEMPERATURE = T = 95.0											
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35			
80.0	8.5	63.9	71.3	74.0	75.4	76.3	76.9	77.3			
100.0	35.3	68.6	74.3	76.0	76.9	77.5	77.9	78.2			
120.0	58.5	74.8	77.1	77.9	78.4	78.7	78.9	79.0			
140.0	78.8	79.6	78.8	79.8	79.8	79.8	79.9	79.9			
160.0	97.1	84.1	82.3	81.6	81.2	81.0	80.8	80.7			
180.0	113.8	88.2	84.7	83.3	82.6	82.1	81.7	81.5			
200.0	129.1	92.0	87.1	85.0	83.9	83.1	82.6	82.3			
220.0	143.3	95.6	89.3	86.6	85.1	84.2	83.5	83.1			
240.0	156.5	99.0	91.4	88.2	86.4	85.2	84.4	83.8			
260.0	169.0	102.2	93.5	89.7	87.6	86.2	85.3	84.6			
280.0	180.8	105.2	95.5	91.2	88.8	87.2	86.1	85.3			
300.0	191.9	108.0	97.4	92.6	89.9	88.2	87.0	86.1			
320.0	202.5	110.7	99.2	94.0	91.1	89.2	87.8	86.8			
340.0	212.6	113.3	101.0	95.4	92.2	90.1	88.6	87.5			
360.0	222.3	115.7	102.7	96.7	93.3	91.0	89.4	88.2			
380.0	231.6	118.1	104.3	98.0	94.3	91.9	90.2	88.9			
400.0	240.5	120.3	105.9	99.3	95.4	92.8	90.9	89.6			
420.0	249.1	122.5	107.5	100.5	96.4	93.7	91.7	90.2			
440.0	257.4	124.6	109.0	101.7	97.4	94.5	92.5	90.9			
460.0	265.4	126.6	110.4	102.9	98.3	95.3	93.2	91.6			

DEWPOINT TEMPERATURE = R = 80.0  
AIR TEMPERATURE = T = 100.0

Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	69.5	75.9	78.6	80.0	80.9	81.5	81.9
100.0	35.3	73.8	79.6	80.4	81.4	82.0	82.4	82.7
120.0	58.5	78.7	81.2	82.2	82.7	83.1	83.3	83.4
140.0	78.8	83.2	83.7	83.9	84.0	84.1	84.2	84.2
160.0	97.1	87.3	86.1	85.6	85.3	85.1	85.0	84.9
180.0	113.9	91.2	88.3	87.2	86.5	86.2	85.9	85.7
200.0	129.1	94.9	90.5	88.7	87.8	87.1	86.7	86.4
220.0	147.3	98.3	92.6	90.2	88.9	88.1	87.5	87.1
240.0	156.5	101.5	94.6	91.7	90.1	89.1	88.4	87.8
260.0	169.0	104.5	96.5	93.1	91.2	90.0	89.2	88.5
280.0	180.8	107.4	98.4	94.5	92.3	90.9	89.9	89.2
300.0	191.9	110.1	100.2	95.6	93.4	91.8	90.7	89.8
320.0	202.5	112.7	101.9	97.2	94.5	92.7	91.5	90.6
340.0	212.6	115.2	103.6	98.4	95.5	93.6	92.2	91.2
360.0	222.3	117.5	105.2	99.7	96.5	94.4	93.0	91.9
380.0	231.6	119.8	106.8	100.9	97.5	95.3	93.7	92.5
400.0	240.5	122.0	108.3	102.1	98.5	96.1	94.4	93.1
420.0	249.1	124.1	109.8	103.2	99.4	96.9	95.1	93.8
440.0	257.4	126.1	111.2	104.4	100.3	97.7	95.8	94.4
460.0	265.4	128.0	112.6	105.5	101.3	98.5	96.5	95.0

DEWPOINT TEMPERATURE = R = 85.0  
AIR TEMPERATURE = T = 105.0

Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35
80.0	8.5	73.2	80.6	83.3	84.7	85.5	86.1	86.5
100.0	35.3	78.1	83.1	85.0	85.9	86.5	86.9	87.2
120.0	58.5	82.6	85.5	86.6	87.2	87.5	87.7	87.9
140.0	78.8	86.8	87.8	88.1	88.3	88.5	88.5	88.6
160.0	97.1	90.7	90.0	89.7	89.5	89.4	89.3	89.3
180.0	113.8	94.4	92.1	91.1	90.6	90.3	90.1	90.0
200.0	129.1	97.8	94.1	92.6	91.8	91.2	90.9	90.6
220.0	143.3	101.1	96.0	94.0	92.8	92.1	91.6	91.3
240.0	156.5	104.1	97.9	95.3	93.9	93.0	92.4	91.9
260.0	169.0	107.0	99.7	96.6	94.9	93.9	93.1	92.6
280.0	180.8	109.7	101.5	97.9	96.0	94.7	93.8	93.2
300.0	191.9	112.3	103.1	99.2	97.0	95.5	94.6	93.8
320.0	202.5	114.8	104.8	100.4	97.9	96.4	95.3	94.4
340.0	212.6	117.2	106.4	101.6	98.9	97.2	95.9	95.0
360.0	222.3	119.5	107.9	102.8	99.8	98.0	96.6	95.6
380.0	231.6	121.7	109.4	103.8	100.8	98.7	97.3	96.2
400.0	240.5	123.8	110.8	105.0	101.7	99.5	98.0	96.8
420.0	249.1	125.8	112.2	106.1	102.6	100.3	98.6	97.4
440.0	257.4	127.8	113.6	107.2	103.4	101.0	99.3	98.0
460.0	265.4	129.6	114.9	108.2	104.3	101.7	99.9	98.5

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 20.0 AIR TEMPERATURE = T = 50.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	27.9	32.0	33.8	34.8	35.4	35.8	36.1		
100.0	35.3	37.2	37.5	37.7	37.8	37.9	37.9	37.9		
120.0	58.5	45.5	42.7	41.4	40.7	40.3	39.9	39.7		
140.0	78.8	53.0	47.5	45.0	43.5	42.6	41.9	41.4		
160.0	97.1	59.8	51.9	48.3	46.2	44.8	43.8	43.1		
180.0	113.8	65.9	56.1	51.5	48.8	47.0	45.7	44.7		
200.0	129.1	71.5	60.0	54.5	51.2	49.0	47.5	46.3		
220.0	143.3	76.7	63.7	57.4	53.6	51.1	49.2	47.9		
240.0	156.5	81.4	67.1	60.1	55.9	53.0	50.9	49.4		
260.0	169.0	85.7	70.4	62.7	58.1	54.9	52.6	50.9		
280.0	180.8	89.8	73.4	65.2	60.2	56.7	54.2	52.3		
300.0	191.9	93.5	76.3	67.6	62.2	58.5	55.8	53.7		
320.0	202.5	97.1	79.1	69.9	64.2	60.2	57.3	55.1		
340.0	212.6	100.4	81.7	72.1	66.0	61.9	58.8	56.4		
360.0	222.3	103.5	84.2	74.2	67.9	63.5	60.2	57.7		
380.0	231.6	106.4	86.6	76.2	69.6	65.0	61.6	59.0		
400.0	240.5	109.2	88.9	78.2	71.3	66.6	63.0	60.2		
420.0	249.1	111.9	91.0	80.0	73.0	68.0	64.3	61.5		
440.0	257.4	114.4	93.1	81.9	74.6	69.5	65.6	62.6		
460.0	265.4	116.8	95.1	83.6	76.2	70.9	66.9	63.8		

  

DEWPOINT TEMPERATURE = R = 30.0 AIR TEMPERATURE = T = 60.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	33.7	38.7	40.8	42.0	42.7	43.2	43.6		
100.0	35.3	42.4	43.8	44.4	44.7	44.9	45.1	45.2		
120.0	58.5	50.2	48.5	47.7	47.3	47.1	46.9	46.8		
140.0	78.8	57.2	52.9	50.9	49.8	49.1	48.6	48.3		
160.0	97.1	63.6	57.0	54.0	52.3	51.1	50.4	49.8		
180.0	113.8	69.4	60.8	56.9	54.6	53.1	52.0	51.2		
200.0	129.1	74.7	64.4	59.6	56.8	55.0	53.6	52.7		
220.0	143.3	79.5	67.8	62.3	58.0	56.8	55.2	54.1		
240.0	156.5	84.0	71.0	64.8	61.0	58.5	56.8	55.4		
260.0	169.0	88.2	74.0	67.2	63.0	60.2	58.2	56.7		
280.0	180.8	92.0	76.9	69.5	65.0	61.9	59.7	58.0		
300.0	191.9	95.7	79.6	71.7	66.8	63.5	61.1	59.3		
320.0	202.5	99.1	82.2	73.8	68.6	65.1	62.5	60.5		
340.0	212.6	102.2	84.7	75.8	70.3	66.6	63.8	61.7		
360.0	222.3	105.3	87.0	77.8	72.0	68.1	65.2	62.9		
380.0	231.6	108.1	89.3	79.7	73.7	69.5	66.4	64.1		
400.0	240.5	110.8	91.4	81.5	75.2	70.9	67.7	65.2		
420.0	249.1	113.4	93.5	83.2	76.8	72.2	68.9	66.3		
440.0	257.4	115.9	95.5	84.9	78.2	73.6	70.1	67.4		
460.0	265.4	118.2	97.4	86.6	79.7	74.9	71.3	68.5		

DEWPOINT TEMPERATURE = R = 35.0 AIR TEMPERATURE = T = 65.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	36.7	42.2	44.4	45.7	46.4	46.9	47.3		
100.0	35.3	45.1	47.0	47.8	48.2	48.5	48.7	48.8		
120.0	58.5	52.6	51.5	51.0	50.7	50.5	50.4	50.3		
140.0	78.8	59.4	55.7	54.0	53.1	52.5	52.1	51.8		
160.0	97.1	65.6	59.6	56.9	55.4	54.4	53.7	53.2		
180.0	113.8	71.2	63.3	59.6	57.6	56.2	55.3	54.6		
200.0	129.1	76.3	66.7	62.3	59.7	58.0	56.8	55.9		
220.0	143.3	81.1	70.0	64.8	61.7	59.7	58.3	57.2		
240.0	156.5	85.4	73.1	67.2	63.7	61.4	59.7	58.5		
260.0	169.0	89.5	76.0	69.5	65.6	63.0	61.1	59.7		
280.0	180.8	93.3	78.7	71.7	67.4	64.6	62.5	61.0		
300.0	191.9	96.8	81.4	73.8	69.2	66.1	63.9	62.2		
320.0	202.5	100.1	83.9	75.8	70.9	67.6	65.2	63.3		
340.0	212.6	103.3	86.3	77.8	72.6	69.0	66.4	64.5		
360.0	222.3	106.2	88.5	79.7	74.2	70.4	67.7	65.6		
380.0	231.6	109.0	90.7	81.5	75.7	71.8	68.9	66.7		
400.0	240.5	111.7	92.8	83.2	77.3	73.1	70.1	67.6		
420.0	249.1	114.2	94.8	84.9	78.7	74.4	71.3	68.8		
440.0	257.4	116.6	96.8	86.6	80.2	75.7	72.4	69.9		
460.0	265.4	119.0	98.6	88.2	81.5	76.9	73.5	70.9		

  

DEWPOINT TEMPERATURE = R = 25.0 AIR TEMPERATURE = T = 55.0										
Q <sub>w</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	30.8	35.4	37.3	38.4	39.0	39.5	39.8		
100.0	35.3	39.7	40.6	41.0	41.2	41.4	41.5	41.5		
120.0	58.5	47.8	45.5	44.6	44.0	43.6	43.4	43.2		
140.0	78.8	55.1	50.1	47.9	46.7	45.8	45.3	44.8		
160.0	97.1	61.6	54.4	51.1	49.2	48.0	47.1	46.4		
180.0	113.8	67.6	58.4	54.1	51.6	50.0	48.8	48.0		
200.0	129.1	73.1	62.2	57.0	54.0	52.0	50.6	49.5		
220.0	143.3	78.1	65.7	59.8	56.3	53.9	52.2	51.0		
240.0	156.5	82.7	69.0	62.4	59.4	55.8	53.8	52.4		
260.0	169.0	86.9	72.2	64.9	60.5	57.6	55.4	53.8		
280.0	180.8	90.9	75.1	67.3	62.5	59.3	56.9	55.2		
300.0	191.9	94.6	78.0	69.4	64.5	61.0	58.4	56.5		
320.0	202.5	98.0	80.6	71.8	66.4	62.6	59.9	57.8		
340.0	212.6	101.3	83.4	73.9	68.2	64.2	61.3	59.1		
360.0	222.3	104.4	85.6	76.0	69.9	65.7	62.7	60.3		
380.0	231.6	107.3	87.9	77.9	71.6	67.2	64.0	61.5		
400.0	240.5	110.0	90.1	79.8	73.3	68.7	65.3	62.7		
420.0	249.1	112.6	92.2	81.6	74.9	70.1	66.6	63.9		
440.0	257.4	115.1	94.3	83.4	76.4	71.5	67.8	65.0		
460.0	265.4	117.5	96.2	85.1	77.9	72.8	69.1	66.1		

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 40.0 AIR TEMPERATURE = T = 70.0										
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	39.9	45.7	48.1	49.4	50.2	50.7	51.1		
100.0	35.3	47.9	50.3	51.3	51.8	52.2	52.4	52.6		
120.0	58.5	55.2	54.5	54.3	54.1	54.1	54.0	53.9		
140.0	78.8	61.7	58.5	57.2	56.4	55.9	55.5	55.3		
160.0	97.1	67.7	62.3	59.9	58.5	57.7	57.1	56.8		
180.0	113.8	73.1	65.8	62.5	60.6	59.4	58.5	57.9		
200.0	129.1	78.1	69.1	65.0	62.6	61.1	60.0	59.2		
220.0	143.3	82.7	72.2	67.4	64.6	62.7	61.4	60.4		
240.0	156.5	86.9	75.2	69.7	66.4	64.3	62.8	61.6		
260.0	169.0	90.9	78.0	71.9	68.2	65.8	64.1	62.8		
280.0	180.8	94.6	80.6	74.0	70.0	67.3	65.4	64.0		
300.0	191.9	98.0	83.2	76.0	71.7	68.8	66.7	65.1		
320.0	202.5	101.3	85.6	77.9	73.3	70.2	67.9	66.2		
340.0	212.6	104.3	87.9	79.8	74.9	71.5	69.1	67.3		
360.0	222.3	107.2	90.1	81.6	76.4	72.9	70.3	68.3		
380.0	231.6	110.0	92.2	83.4	77.9	74.2	71.5	69.4		
400.0	240.5	112.6	94.3	85.1	79.4	75.5	72.6	70.4		
420.0	249.1	115.1	96.2	86.7	80.8	76.7	73.7	71.4		
440.0	257.4	117.5	98.1	88.3	82.1	77.9	74.8	72.4		
460.0	265.4	119.7	99.9	89.8	83.5	79.1	75.8	73.3		

  

DEWPOINT TEMPERATURE = R = 50.0 AIR TEMPERATURE = T = 80.0										
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	46.6	53.1	55.7	57.1	57.9	58.5	58.9		
100.0	35.3	54.0	57.2	58.5	59.2	59.8	59.9	60.2		
120.0	58.5	60.6	61.0	61.2	61.2	61.3	61.3	61.4		
140.0	78.8	66.7	64.6	63.7	63.2	62.9	62.7	62.5		
160.0	97.1	72.2	68.0	66.1	65.1	64.5	64.0	63.7		
180.0	113.8	77.2	71.1	68.5	67.0	66.0	65.3	64.8		
200.0	129.1	81.9	74.1	70.7	68.7	67.5	66.6	65.9		
220.0	143.3	86.2	77.0	72.8	70.5	68.9	67.8	67.0		
240.0	156.5	90.2	79.7	74.9	72.1	70.3	69.0	68.1		
260.0	169.0	93.9	82.3	76.9	73.8	71.7	70.2	69.1		
280.0	180.8	97.4	84.7	78.8	75.3	73.0	71.4	70.2		
300.0	191.9	100.7	87.1	80.6	76.8	74.3	72.5	71.2		
320.0	202.5	103.7	89.3	82.4	78.3	75.8	73.6	72.1		
340.0	212.6	106.7	91.4	84.1	79.8	76.8	74.7	73.1		
360.0	222.3	109.4	93.5	85.8	81.1	78.0	75.8	74.0		
380.0	231.6	112.1	95.5	87.4	82.5	79.2	76.8	75.0		
400.0	240.5	114.6	97.4	89.0	83.8	80.3	77.8	75.9		
420.0	249.1	117.0	99.2	90.5	85.1	81.5	78.8	76.8		
440.0	257.4	119.3	101.0	91.9	86.4	82.6	79.8	77.7		
460.0	265.4	121.5	102.7	93.4	87.6	83.6	80.7	78.5		

  

DEWPOINT TEMPERATURE = R = 55.0 AIR TEMPERATURE = T = 85.0										
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35		
80.0	8.5	50.2	57.0	59.6	61.0	61.9	62.5	62.9		
100.0	35.3	57.2	60.8	62.2	63.0	63.5	63.8	64.1		
120.0	58.5	63.6	64.4	64.7	64.9	65.0	65.1	65.2		
140.0	78.8	69.3	67.8	67.1	66.8	66.5	66.4	66.3		
160.0	97.1	74.6	71.0	69.4	68.6	68.0	67.6	67.4		
180.0	113.8	79.4	74.0	71.6	70.3	69.4	68.8	68.4		
200.0	129.1	83.9	76.8	73.7	71.9	70.8	70.0	69.4		
220.0	143.3	88.1	79.5	75.7	73.6	72.2	71.2	70.5		
240.0	156.5	91.9	82.1	77.7	75.1	73.5	72.3	71.4		
260.0	169.0	95.5	84.6	79.6	76.7	74.8	73.4	72.4		
280.0	180.8	98.9	86.9	81.4	78.1	76.0	74.5	73.4		
300.0	191.9	102.1	89.2	83.1	79.6	77.2	75.6	74.3		
320.0	202.5	105.1	91.3	84.8	81.0	78.4	76.6	75.2		
340.0	212.6	108.0	93.4	86.5	82.3	79.6	77.6	76.1		
360.0	222.3	110.7	95.4	88.0	83.7	80.7	78.6	77.0		
380.0	231.6	113.3	97.3	89.6	84.9	81.8	79.6	77.9		
400.0	240.5	115.7	99.1	91.1	86.2	82.9	80.6	78.8		
420.0	249.1	118.1	100.9	92.5	87.4	84.0	81.5	79.6		
440.0	257.4	120.3	102.6	93.9	88.6	85.0	82.4	80.4		
460.0	265.4	122.5	104.3	95.3	89.8	86.1	83.3	81.2		

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 60.0 AIR TEMPERATURE = T = 90.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	54.0	61.0	63.7	65.1	66.0	66.5	67.0				
100.0	35.3	60.6	64.5	66.1	66.9	67.4	67.8	68.0				
120.0	58.5	86.6	87.9	88.4	88.7	88.9	89.0	89.1				
140.0	78.8	102.1	101.1	100.6	100.4	100.3	100.2	100.1				
160.0	97.1	117.2	116.1	115.6	115.4	115.3	115.2	115.1				
180.0	113.8	133.8	132.7	132.2	132.0	131.9	131.8	131.7				
200.0	129.1	148.1	146.9	146.4	146.2	146.1	146.0	145.9				
220.0	143.3	161.6	160.3	159.8	159.6	159.5	159.4	159.3				
240.0	156.5	174.8	173.4	172.9	172.7	172.6	172.5	172.4				
260.0	169.0	186.1	184.6	184.1	184.0	183.9	183.8	183.7				
280.0	180.8	196.8	195.2	194.6	194.4	194.3	194.2	194.1				
300.0	191.9	206.9	205.2	204.6	204.4	204.3	204.2	204.1				
320.0	202.5	216.6	214.8	214.2	214.0	213.9	213.8	213.7				
340.0	212.6	225.5	223.6	223.0	222.8	222.7	222.6	222.5				
360.0	222.3	233.6	231.6	231.0	230.8	230.7	230.6	230.5				
380.0	231.6	240.5	238.4	237.8	237.6	237.5	237.4	237.3				
400.0	240.5	249.1	246.9	246.3	246.1	246.0	245.9	245.8				
420.0	249.1	257.4	255.2	254.6	254.4	254.3	254.2	254.1				
440.0	257.4	265.4	263.1	262.5	262.3	262.2	262.1	262.0				
460.0	265.4											

  

DEWPOINT TEMPERATURE = R = 70.0 AIR TEMPERATURE = T = 100.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	62.0	69.3	72.0	73.4	74.3	74.9	75.3				
100.0	35.3	87.8	92.4	94.1	95.0	95.6	95.9	96.2				
120.0	58.5	110.2	113.8	115.4	116.2	116.7	117.0	117.2				
140.0	78.8	129.1	132.7	134.2	135.0	135.4	135.6	135.7				
160.0	97.1	147.9	150.3	151.8	152.5	152.8	153.0	153.1				
180.0	113.8	166.6	168.0	169.4	170.0	170.3	170.5	170.6				
200.0	129.1	180.8	181.9	183.2	183.8	184.1	184.3	184.4				
220.0	143.3	194.5	195.4	196.6	197.1	197.4	197.6	197.7				
240.0	156.5	207.8	208.5	209.6	210.0	210.3	210.5	210.6				
260.0	169.0	220.5	221.1	222.1	222.5	222.8	223.0	223.1				
280.0	180.8	232.3	232.8	233.7	234.1	234.4	234.6	234.7				
300.0	191.9	243.6	244.0	244.8	245.1	245.4	245.6	245.7				
320.0	202.5	254.5	254.8	255.5	255.8	256.0	256.2	256.3				
340.0	212.6	265.0	265.2	265.8	266.1	266.3	266.5	266.6				
360.0	222.3	275.1	275.3	275.8	276.1	276.3	276.5	276.6				
380.0	231.6	284.8	284.9	285.3	285.6	285.8	285.9	286.0				
400.0	240.5	294.1	294.1	294.4	294.6	294.7	294.8	294.9				
420.0	249.1	302.9	302.9	303.1	303.2	303.3	303.4	303.4				
440.0	257.4	311.2	311.2	311.3	311.4	311.4	311.5	311.5				
460.0	265.4											

  

DEWPOINT TEMPERATURE = R = 75.0 AIR TEMPERATURE = T = 105.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	64.2	73.6	76.3	77.7	78.6	79.2	79.6				
100.0	35.3	91.7	100.3	103.0	104.4	105.1	105.5	105.7				
120.0	58.5	114.2	121.8	124.4	125.8	126.5	126.9	127.1				
140.0	78.8	132.7	139.4	141.9	143.3	143.9	144.2	144.4				
160.0	97.1	150.3	156.0	158.4	159.8	160.3	160.6	160.7				
180.0	113.8	167.8	172.5	174.8	176.2	176.7	177.0	177.1				
200.0	129.1	184.5	188.1	190.4	191.8	192.3	192.5	192.6				
220.0	143.3	199.8	202.9	205.1	206.4	206.9	207.1	207.2				
240.0	156.5	214.5	217.4	219.6	220.9	221.4	221.6	221.7				
260.0	169.0	228.8	231.5	233.7	234.9	235.4	235.6	235.7				
280.0	180.8	242.3	244.8	246.9	248.1	248.6	248.8	248.9				
300.0	191.9	255.2	257.4	259.4	260.6	261.0	261.2	261.3				
320.0	202.5	267.6	269.5	271.4	272.6	273.0	273.2	273.3				
340.0	212.6	279.1	280.8	282.5	283.7	284.1	284.3	284.4				
360.0	222.3	290.1	291.6	293.1	294.3	294.7	294.9	295.0				
380.0	231.6	300.6	301.9	303.2	304.3	304.7	304.9	305.0				
400.0	240.5	310.6	311.7	312.8	313.8	314.2	314.4	314.5				
420.0	249.1	320.1	321.1	322.1	323.0	323.4	323.6	323.7				
440.0	257.4	329.1	329.9	330.8	331.6	331.9	332.1	332.2				
460.0	265.4											

  

DEWPOINT TEMPERATURE = R = 80.0 AIR TEMPERATURE = T = 110.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	67.9	77.3	80.0	81.4	82.3	82.9	83.3				
100.0	35.3	95.4	104.8	107.5	108.9	109.6	110.0	110.2				
120.0	58.5	118.9	127.4	130.1	131.5	132.2	132.6	132.8				
140.0	78.8	137.8	145.3	147.9	149.3	150.0	150.3	150.5				
160.0	97.1	156.6	163.1	165.6	166.9	167.6	167.9	168.1				
180.0	113.8	175.1	180.6	183.1	184.4	185.1	185.4	185.6				
200.0	129.1	193.1	197.6	200.1	201.4	202.1	202.4	202.6				
220.0	143.3	210.6	214.1	216.6	217.9	218.6	218.9	219.0				
240.0	156.5	227.1	230.6	233.1	234.4	235.1	235.4	235.5				
260.0	169.0	243.6	246.1	248.6	249.9	250.6	250.9	251.0				
280.0	180.8	259.1	261.6	264.1	265.4	266.1	266.4	266.5				
300.0	191.9	274.6	277.1	279.6	280.9	281.6	281.9	282.0				
320.0	202.5	289.1	291.6	294.1	295.4	296.1	296.4	296.5				
340.0	212.6	303.6	306.1	308.6	309.9	310.6	310.9	311.0				
360.0	222.3	318.1	320.6	323.1	324.4	325.1	325.4	325.5				
380.0	231.6	332.6	335.1	337.6	338.9	339.6	339.9	340.0				
400.0	240.5	347.1	349.6	352.1	353.4	354.1	354.4	354.5				
420.0	249.1	361.6	364.1	366.6	367.9	368.6	368.9	369.0				
440.0	257.4	376.1	378.6	381.1	382.4	383.1	383.4	383.5				
460.0	265.4											

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 20.0 AIR TEMPERATURE = T = 60.0											
Q <sub>m</sub>	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>m</sub>	W=5	W=10	W=15
80.0	8.5	31.7	36.4	38.4	39.5	40.2	40.7	80.0	8.5	37.2	42.7
100.0	35.3	40.5	41.6	42.1	42.3	42.5	42.6	100.0	35.3	43.5	47.5
120.0	58.5	48.5	46.5	45.6	45.0	44.7	44.5	120.0	58.5	53.0	51.9
140.0	78.8	55.7	51.0	48.9	47.7	46.9	46.3	140.0	78.8	59.7	56.1
160.0	97.1	62.2	55.2	52.0	50.2	48.0	47.5	160.0	97.1	65.9	60.0
180.0	113.8	68.2	59.2	55.0	52.6	51.0	49.0	180.0	113.8	71.5	63.6
200.0	129.1	73.8	62.9	57.8	54.9	52.8	51.5	200.0	129.1	76.6	67.1
220.0	143.3	78.5	66.4	60.6	57.1	54.8	53.2	220.0	143.3	81.3	70.3
240.0	158.5	83.1	69.7	63.1	59.2	56.6	54.8	240.0	158.5	85.7	73.4
260.0	169.0	87.3	72.8	65.6	61.3	58.4	56.3	260.0	169.0	89.7	76.3
280.0	180.8	91.2	75.7	68.0	63.3	60.1	57.8	280.0	180.8	93.5	79.0
300.0	193.9	94.9	78.5	70.3	65.2	61.8	59.3	300.0	193.9	97.0	81.6
320.0	202.5	98.4	81.1	72.4	67.1	63.4	60.7	320.0	202.5	100.3	84.1
340.0	212.6	101.5	83.6	74.5	68.8	64.9	62.1	340.0	212.6	103.4	86.5
360.0	222.3	104.5	86.0	76.5	70.6	66.5	63.4	360.0	222.3	106.4	88.8
380.0	231.6	107.5	88.3	78.5	72.3	67.9	64.8	380.0	231.6	109.2	90.9
400.0	240.5	110.5	90.5	80.3	73.9	69.4	66.1	400.0	240.5	111.8	93.0
420.0	249.1	112.5	92.6	82.1	75.4	70.8	67.2	420.0	249.1	114.3	95.0
440.0	257.4	115.4	94.7	83.9	77.0	72.1	68.5	440.0	257.4	116.8	97.0
460.0	265.4	117.7	96.6	85.5	78.5	73.5	69.7	460.0	265.4	119.1	98.8

  

DEWPOINT TEMPERATURE = R = 30.0 AIR TEMPERATURE = T = 70.0											
Q <sub>m</sub>	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>m</sub>	W=5	W=10	W=15
80.0	8.5	37.2	42.7	45.0	46.2	47.0	47.5	80.0	8.5	40.1	46.0
100.0	35.3	43.5	47.5	48.3	48.8	49.1	49.3	100.0	35.3	48.1	50.5
120.0	58.5	53.0	51.9	51.5	51.2	51.1	50.9	120.0	58.5	54.8	54.5
140.0	78.8	59.7	56.1	54.5	53.6	53.0	52.6	140.0	78.8	61.9	57.4
160.0	97.1	65.9	60.0	57.3	55.8	54.9	54.2	160.0	97.1	67.8	62.5
180.0	113.8	71.5	63.6	60.1	58.0	56.7	55.8	180.0	113.8	73.2	66.0
200.0	129.1	76.6	67.1	62.7	60.1	58.5	57.3	200.0	129.1	78.2	69.3
220.0	143.3	81.3	70.3	65.2	62.1	60.2	57.7	220.0	143.3	82.8	72.4
240.0	158.5	85.7	73.4	67.5	64.1	61.8	60.2	240.0	158.5	87.0	75.3
260.0	169.0	89.7	76.3	69.8	66.0	63.4	61.6	260.0	169.0	91.0	78.1
280.0	180.8	93.5	79.0	72.0	67.8	65.0	62.9	280.0	180.8	94.6	80.8
300.0	193.9	97.0	81.6	74.1	69.6	66.5	64.3	300.0	193.9	98.1	83.3
320.0	202.5	100.3	84.1	76.1	71.3	68.0	65.6	320.0	202.5	101.3	85.7
340.0	212.6	103.4	86.5	78.1	72.9	69.4	66.8	340.0	212.6	104.4	88.0
360.0	222.3	106.4	88.8	80.0	74.5	70.8	68.1	360.0	222.3	107.3	90.2
380.0	231.6	109.2	90.9	81.8	76.1	72.2	69.3	380.0	231.6	110.0	92.3
400.0	240.5	111.8	93.0	83.5	77.6	73.5	70.5	400.0	240.5	112.7	94.4
420.0	249.1	114.3	95.0	85.2	79.0	74.8	71.6	420.0	249.1	115.1	96.3
440.0	257.4	116.8	97.0	86.8	80.5	76.0	72.8	440.0	257.4	117.5	98.2
460.0	265.4	119.1	98.8	88.4	81.8	77.3	73.9	460.0	265.4	119.8	100.0

  

DEWPOINT TEMPERATURE = R = 35.0 AIR TEMPERATURE = T = 75.0											
Q <sub>m</sub>	W=5	W=10	W=15	W=20	W=25	W=30	W=35	Q <sub>m</sub>	W=5	W=10	W=15
80.0	8.5	40.1	46.0	48.4	49.6	50.4	51.0	80.0	8.5	48.1	50.5
100.0	35.3	48.1	50.5	51.5	52.1	52.4	52.6	100.0	35.3	54.8	54.5
120.0	58.5	54.8	54.5	54.4	54.4	54.4	54.2	120.0	58.5	61.9	57.4
140.0	78.8	61.9	57.4	56.6	56.1	55.8	55.5	140.0	78.8	67.8	62.5
160.0	97.1	67.8	62.5	60.1	58.8	57.5	57.3	160.0	97.1	73.2	66.0
180.0	113.8	73.2	66.0	62.7	60.8	59.6	58.8	180.0	113.8	78.2	69.3
200.0	129.1	78.2	69.3	65.2	62.8	61.3	60.2	200.0	129.1	82.8	72.4
220.0	143.3	82.8	72.4	67.6	64.8	62.9	61.6	220.0	143.3	87.0	75.3
240.0	158.5	87.0	75.3	69.8	66.6	64.5	63.0	240.0	158.5	91.0	78.1
260.0	169.0	91.0	78.1	72.0	68.4	66.0	64.3	260.0	169.0	94.6	80.8
280.0	180.8	94.6	80.8	74.1	70.1	67.5	65.6	280.0	180.8	98.1	83.3
300.0	193.9	98.1	83.3	76.1	71.8	68.9	66.9	300.0	193.9	101.3	85.7
320.0	202.5	101.3	85.7	78.1	73.5	70.3	68.1	320.0	202.5	104.4	88.0
340.0	212.6	104.4	88.0	80.0	75.0	71.7	69.3	340.0	212.6	107.3	90.2
360.0	222.3	107.3	90.2	81.8	76.6	73.0	70.5	360.0	222.3	110.0	92.3
380.0	231.6	110.0	92.3	83.5	78.1	74.3	71.6	380.0	231.6	112.7	94.4
400.0	240.5	112.7	94.4	85.2	79.5	75.6	72.8	400.0	240.5	115.1	96.3
420.0	249.1	115.1	96.3	86.8	80.9	76.8	73.9	420.0	249.1	117.5	98.2
440.0	257.4	117.5	98.2	88.4	82.3	78.1	74.9	440.0	257.4	119.8	100.0
460.0	265.4	119.8	100.0	89.9	83.6	79.2	76.0	460.0	265.4	122.1	101.7

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 40.0 AIR TEMPERATURE = T = 80.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	43.2	49.3	51.8	53.1	54.0	54.5	54.9				
100.0	35.3	50.8	53.6	54.8	55.4	55.8	56.1	56.3				
120.0	58.5	57.8	57.7	57.6	57.6	57.6	57.6	57.6				
140.0	78.8	64.1	61.5	60.3	59.7	59.3	59.0	58.8				
160.0	97.1	69.8	65.0	62.9	61.7	61.0	60.5	60.1				
180.0	113.7	75.1	68.4	65.4	63.7	62.6	61.9	61.3				
200.0	129.1	79.9	71.5	67.8	65.6	64.2	63.2	62.5				
220.0	143.3	84.3	74.5	70.0	67.4	65.7	64.5	63.6				
240.0	156.5	88.5	77.3	72.2	69.2	67.2	65.8	64.8				
260.0	169.0	92.3	80.0	74.3	70.9	68.7	67.1	65.9				
280.0	180.8	95.9	82.6	76.3	72.6	70.1	68.3	67.0				
300.0	191.9	99.3	85.0	78.2	74.2	71.5	69.5	68.0				
320.0	202.5	102.4	87.4	80.1	75.7	72.8	70.7	69.1				
340.0	212.6	105.4	89.6	81.9	77.2	74.1	71.8	70.1				
360.0	222.3	108.3	91.7	83.6	78.7	75.4	72.9	71.1				
380.0	231.6	111.0	93.8	85.3	80.1	76.6	74.0	72.1				
400.0	240.5	113.5	95.8	86.9	81.5	77.8	75.1	73.1				
420.0	249.1	116.0	97.7	88.5	82.9	79.0	76.2	74.9				
440.0	257.4	118.3	99.5	90.0	84.2	80.1	77.2	74.9				
460.0	265.4	120.6	101.3	91.5	85.5	81.3	78.2	75.8				

  

DEWPOINT TEMPERATURE = R = 50.0 AIR TEMPERATURE = T = 90.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	49.6	56.3	59.0	60.3	61.2	61.8	62.2				
100.0	35.3	56.7	60.2	61.6	62.3	62.8	63.1	63.4				
120.0	58.5	63.0	63.8	64.1	64.3	64.4	64.5	64.5				
140.0	78.8	68.9	67.2	66.5	66.1	65.9	65.7	65.6				
160.0	97.1	74.2	70.4	68.8	68.0	67.4	67.0	66.7				
180.0	113.7	79.0	73.5	71.1	69.7	68.8	68.2	67.8				
200.0	129.1	83.8	76.3	73.2	71.4	70.2	69.4	68.8				
220.0	143.3	87.7	79.1	75.2	73.0	71.6	70.6	69.9				
240.0	156.5	91.6	81.7	77.2	74.6	72.9	71.7	70.9				
260.0	169.0	95.2	84.2	79.1	76.2	74.2	72.9	71.8				
280.0	180.8	98.6	86.5	80.9	77.6	75.5	74.0	72.8				
300.0	191.9	101.9	88.8	82.7	79.1	76.7	75.0	73.8				
320.0	202.5	104.9	91.0	84.4	80.5	77.9	76.1	74.7				
340.0	212.6	107.7	93.0	86.0	81.9	79.1	77.1	75.6				
360.0	222.3	110.5	95.0	87.6	83.2	80.3	78.1	76.5				
380.0	231.6	113.1	97.0	89.2	84.5	81.4	79.1	77.4				
400.0	240.5	115.5	98.8	90.7	85.8	82.5	80.1	78.3				
420.0	249.1	117.9	100.6	92.2	87.0	83.5	81.0	79.1				
440.0	257.4	120.1	102.3	93.6	88.2	84.6	82.0	79.9				
460.0	265.4	122.3	104.0	95.0	89.4	85.6	82.9	80.8				

  

DEWPOINT TEMPERATURE = R = 55.0 AIR TEMPERATURE = T = 95.0												
Q <sub>m</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35				
80.0	8.5	53.0	60.0	62.7	64.1	64.9	65.5	66.0				
100.0	35.3	59.8	63.6	65.1	65.9	66.5	66.8	67.0				
120.0	58.5	65.9	67.0	67.5	67.8	67.9	68.0	68.1				
140.0	78.8	71.4	70.2	69.8	69.5	69.3	69.2	69.1				
160.0	97.1	76.5	73.3	71.9	71.2	70.7	70.4	70.2				
180.0	113.7	81.2	76.2	74.0	72.8	72.1	71.5	71.2				
200.0	129.1	85.5	78.9	76.0	74.4	73.4	72.7	72.1				
220.0	143.3	89.6	81.5	78.0	76.0	74.7	73.8	73.1				
240.0	156.5	93.3	84.0	79.8	77.5	75.9	74.8	74.0				
260.0	169.0	96.8	86.4	81.6	78.9	77.1	75.9	75.0				
280.0	180.8	100.2	88.6	83.4	80.3	78.3	76.9	75.8				
300.0	191.9	103.3	90.8	85.1	81.7	79.5	77.9	76.8				
320.0	202.5	106.2	92.9	86.7	83.1	80.6	78.9	77.6				
340.0	212.6	109.0	94.9	88.3	84.4	81.8	79.9	78.5				
360.0	222.3	111.7	96.8	89.8	85.6	82.8	80.8	79.3				
380.0	231.6	114.2	98.7	91.3	86.9	83.9	81.8	80.2				
400.0	240.5	116.6	100.5	92.7	88.1	84.9	82.7	81.0				
420.0	249.1	118.9	102.2	94.1	89.3	86.0	83.6	81.8				
440.0	257.4	121.1	103.9	95.5	90.4	87.0	84.5	82.6				
460.0	265.4	123.3	105.5	96.8	91.5	88.0	85.4	83.4				

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 60.0 AIR TEMPERATURE = T = 100.0									
Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	56.6	61.8	66.5	67.9	68.8	69.4	69.8	
100.0	35.3	63.0	67.2	69.8	69.6	70.2	70.5	70.8	
120.0	58.5	68.8	70.4	71.0	71.3	71.5	71.7	71.8	
140.0	78.8	74.1	73.4	73.1	73.0	72.9	72.8	72.7	
160.0	97.1	79.0	76.3	75.2	74.5	74.2	73.8	73.7	
180.0	113.8	83.5	79.0	77.1	76.1	75.4	75.0	74.6	
200.0	129.1	87.7	81.6	78.0	77.6	76.6	76.0	75.5	
220.0	143.3	91.5	84.1	80.8	79.0	77.9	77.0	76.4	
240.0	156.5	95.2	86.4	82.6	80.4	79.0	78.0	77.3	
260.0	169.0	98.6	88.7	84.3	81.8	80.2	79.0	78.2	
280.0	180.8	101.8	90.9	86.0	83.1	81.3	80.0	79.0	
300.0	191.9	104.8	92.9	87.6	84.4	82.4	80.9	79.9	
320.0	202.5	107.7	94.8	89.1	85.7	83.5	81.9	80.7	
340.0	212.6	110.4	96.9	90.6	86.9	84.5	82.8	81.5	
360.0	222.3	113.0	98.7	92.1	88.1	85.5	83.7	82.3	
380.0	231.6	115.4	100.5	93.5	89.3	86.5	84.6	83.1	
400.0	240.5	117.8	102.2	94.9	90.5	87.5	85.4	83.8	
420.0	249.1	120.1	103.9	96.2	91.6	88.5	86.3	84.6	
440.0	257.4	122.2	105.5	97.5	92.7	89.5	87.1	85.4	
460.0	265.4	124.3	107.1	98.8	93.8	90.4	87.9	86.1	

DEWPOINT TEMPERATURE = R = 20.0 AIR TEMPERATURE = T = 70.0									
Q <sub>a</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	35.3	40.5	42.7	43.9	44.6	45.2	45.5	
100.0	35.3	43.8	45.4	46.2	46.5	46.8	47.0	47.2	
120.0	58.5	51.4	50.0	49.4	49.1	48.9	48.7	48.6	
140.0	78.8	54.3	52.5	51.5	50.9	50.4	50.1	50.1	
160.0	97.1	64.6	58.3	55.5	53.9	52.8	52.1	51.6	
180.0	113.8	70.3	62.1	58.3	56.1	54.7	53.7	53.0	
200.0	129.1	75.5	65.6	61.0	58.3	56.5	55.3	54.3	
220.0	143.3	80.3	68.9	63.6	60.4	58.3	56.8	55.7	
240.0	156.5	84.7	72.1	66.0	62.4	60.0	58.3	57.0	
260.0	169.0	88.9	75.0	68.4	64.4	61.7	59.8	58.3	
280.0	180.8	92.7	77.9	70.6	66.2	63.3	61.2	59.6	
300.0	191.9	96.3	80.5	72.8	68.1	64.9	62.5	60.8	
320.0	202.5	99.6	83.1	74.8	69.8	66.4	63.9	62.0	
340.0	212.6	102.8	85.5	76.8	71.5	67.9	65.2	63.2	
360.0	222.3	105.7	87.8	78.8	73.1	69.3	66.5	64.3	
380.0	231.6	108.6	90.0	80.6	74.7	70.7	67.7	65.4	
400.0	240.5	111.3	92.2	82.4	76.3	72.1	68.9	66.5	
420.0	249.1	113.8	94.2	84.1	77.8	73.4	70.1	67.6	
440.0	257.4	116.3	96.2	85.8	79.2	74.7	71.3	68.7	
460.0	265.4	118.6	98.0	87.4	80.7	75.9	72.4	69.7	

DEWPOINT TEMPERATURE = R = 65.0 AIR TEMPERATURE = T = 105.0									
Q=	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	37.9	43.5	45.8	47.0	47.8	48.3	48.7	
100.0	35.3	46.1	48.2	49.1	49.5	49.8	50.0	50.2	
120.0	58.5	53.5	52.6	52.2	52.0	51.8	51.7	51.6	
140.0	78.8	60.2	56.7	55.1	54.3	53.7	53.4	53.0	
160.0	97.1	66.3	60.6	58.0	56.5	55.6	54.9	54.4	
180.0	113.8	71.9	64.2	60.7	58.7	57.4	56.5	55.8	
200.0	129.1	77.0	67.6	63.3	60.8	59.1	57.9	57.1	
220.0	143.3	81.6	70.8	65.7	62.8	60.8	59.4	58.4	
240.0	156.5	86.0	73.8	68.1	64.7	62.4	60.8	59.6	
260.0	169.0	90.0	76.7	70.3	66.5	64.0	62.2	60.8	
280.0	180.8	93.7	79.4	72.5	68.3	65.6	63.6	62.0	
300.0	191.9	97.2	82.0	74.6	70.1	67.1	64.9	63.2	
320.0	202.5	100.5	84.5	76.6	71.8	68.5	66.2	64.4	
340.0	212.6	103.6	86.8	78.5	73.4	69.9	67.4	65.5	
360.0	222.3	106.6	89.1	80.4	75.0	71.3	68.6	66.6	
380.0	231.6	109.4	91.3	82.2	76.5	72.7	69.8	67.7	
400.0	240.5	112.0	93.3	83.9	78.0	74.0	71.0	68.8	
420.0	249.1	114.5	95.3	85.6	79.5	75.2	72.1	69.8	
440.0	257.4	116.9	97.2	87.2	80.9	76.5	73.3	70.8	
460.0	265.4	119.2	99.1	88.8	82.2	77.7	74.4	71.8	

Table 3 (continued)

DEWPOINT TEMPERATURE = R = 30.0 AIR TEMPERATURE = T = 80.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	40.6	46.5	48.9	50.2	51.0	51.5	51.9	
100.0	35.3	48.5	51.0	52.0	52.6	52.9	53.1	53.3	
120.0	58.5	55.7	55.2	55.0	54.9	54.8	54.7	54.7	
140.0	78.8	62.2	59.1	57.8	57.1	56.6	56.3	56.0	
160.0	97.1	68.1	62.8	60.5	59.2	58.4	57.8	57.3	
180.0	113.8	73.5	66.3	63.1	61.3	60.1	59.2	58.6	
200.0	129.1	78.5	69.6	65.6	63.2	61.7	60.7	59.9	
220.0	143.3	83.0	72.7	67.9	65.2	63.3	62.0	61.1	
240.0	156.5	87.2	75.6	70.2	67.0	64.5	63.4	62.3	
260.0	169.0	91.2	78.4	72.4	68.8	66.4	64.7	63.4	
280.0	180.8	94.8	81.0	74.4	70.5	67.9	66.0	64.6	
300.0	191.9	98.3	83.6	76.4	72.2	69.3	67.3	65.7	
320.0	202.5	101.5	86.0	78.4	73.8	70.7	68.5	66.8	
340.0	212.6	104.5	88.2	80.2	75.4	72.1	69.7	67.9	
360.0	222.3	107.4	90.4	82.0	76.9	73.4	70.8	68.9	
380.0	231.6	110.2	92.5	83.8	78.4	74.7	72.0	69.9	
400.0	240.5	112.8	94.6	85.4	79.8	75.9	73.1	70.9	
420.0	249.1	115.3	96.5	87.1	81.2	77.2	74.2	71.9	
440.0	257.4	117.6	98.4	88.6	82.6	78.4	75.3	72.9	
460.0	265.4	119.9	100.2	90.2	83.9	79.5	76.3	73.9	

DEWPOINT TEMPERATURE = R = 40.0 AIR TEMPERATURE = T = 90.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	46.3	52.7	55.3	56.6	57.5	58.1	58.5	
100.0	35.3	53.6	56.8	58.1	58.8	59.2	59.5	59.7	
120.0	58.5	60.3	60.6	60.8	60.8	60.9	60.9	61.0	
140.0	78.8	66.4	64.2	63.3	62.8	62.5	62.3	62.1	
160.0	97.1	71.9	67.6	65.8	64.8	64.1	63.6	63.3	
180.0	113.8	77.0	70.8	68.1	66.6	65.6	65.0	64.4	
200.0	129.1	81.6	73.9	70.4	68.4	67.1	66.2	65.6	
220.0	143.3	86.0	76.7	72.5	70.1	68.6	67.5	66.7	
240.0	156.5	90.0	78.4	74.6	71.8	70.0	68.7	67.7	
260.0	169.0	93.7	82.0	76.6	73.4	71.4	69.9	68.8	
280.0	180.8	97.2	84.5	78.5	75.0	72.7	71.0	69.8	
300.0	191.9	100.5	86.8	80.4	76.6	74.0	72.2	70.8	
320.0	202.5	103.6	89.1	82.2	78.0	75.3	73.3	71.8	
340.0	212.6	106.5	91.2	83.9	79.5	76.5	74.4	72.8	
360.0	222.3	109.3	93.3	85.6	80.9	77.7	75.4	73.7	
380.0	231.6	112.0	95.3	87.2	82.2	78.9	76.5	74.7	
400.0	240.5	114.5	97.2	88.7	83.6	80.1	77.5	75.6	
420.0	249.1	116.9	99.1	90.3	84.9	81.2	78.5	76.5	
440.0	257.4	119.2	100.8	91.7	86.1	82.3	79.5	77.4	
460.0	265.4	121.4	102.6	93.2	87.4	83.4	80.5	78.2	

DEWPOINT TEMPERATURE = R = 45.0 AIR TEMPERATURE = T = 95.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35	
80.0	8.5	49.3	56.0	58.6	60.0	60.9	61.4	61.9	
100.0	35.3	56.4	59.9	61.3	62.0	62.5	62.8	63.0	
120.0	58.5	62.8	63.5	63.8	64.0	64.1	64.1	64.2	
140.0	78.8	68.6	66.9	66.2	65.8	65.6	65.4	65.3	
160.0	97.1	74.0	70.2	68.5	67.7	67.1	66.7	66.4	
180.0	113.8	78.8	73.2	70.8	69.4	68.5	67.9	67.5	
200.0	129.1	83.4	76.1	72.9	71.1	69.9	69.1	68.5	
220.0	143.3	87.6	78.9	75.0	72.8	71.3	70.3	69.6	
240.0	156.5	91.5	81.5	76.9	74.3	72.7	71.5	70.6	
260.0	169.0	95.1	84.0	78.9	75.9	74.0	72.6	71.6	
280.0	180.8	98.5	85.3	80.7	77.4	75.2	73.7	72.5	
300.0	191.9	101.7	88.6	82.5	78.9	76.5	74.8	73.5	
320.0	202.5	104.8	90.8	84.2	80.3	77.7	75.8	74.4	
340.0	212.6	107.6	92.9	85.8	81.7	78.9	76.9	75.3	
360.0	222.3	110.4	94.9	87.4	83.0	80.0	77.9	76.2	
380.0	231.6	112.9	96.8	89.0	84.3	81.1	78.9	77.1	
400.0	240.5	115.4	98.7	90.5	85.6	82.2	79.8	78.0	
420.0	249.1	117.8	100.4	92.0	86.8	83.3	80.8	78.9	
440.0	257.4	120.1	102.2	93.4	88.0	84.4	81.7	79.7	
460.0	265.4	122.2	103.9	94.8	89.2	85.4	82.6	80.5	

Table 3 (continued)

		DEWPOINT TEMPERATURE = R = 50.0 AIR TEMPERATURE = T = 100.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35			
80.0	8.5	52.4	59.3	62.0	63.4	64.3	64.9	65.3			
100.0	35.3	59.2	63.0	64.5	65.3	65.8	66.2	66.4			
120.0	58.5	65.4	66.5	66.9	67.2	67.3	67.4	67.5			
140.0	78.8	71.0	69.7	68.2	68.9	68.7	68.6	68.5			
160.0	97.1	76.1	72.8	71.4	70.6	70.1	69.8	69.6			
180.0	113.8	80.8	75.7	73.5	72.3	71.5	71.0	70.6			
200.0	129.1	85.2	78.5	75.5	73.9	72.8	72.1	71.6			
220.0	143.3	89.2	81.1	77.5	75.5	74.1	73.2	72.5			
240.0	156.5	93.0	83.6	79.4	77.0	75.4	74.3	73.5			
260.0	169.0	96.6	86.0	81.2	78.4	76.6	75.4	74.4			
280.0	180.8	99.9	88.3	83.0	79.9	77.8	76.4	75.3			
300.0	191.9	103.0	90.5	84.6	81.3	79.0	77.4	76.2			
320.0	202.5	106.0	92.6	86.3	82.6	80.2	78.4	77.1			
340.0	212.6	108.8	94.6	87.9	83.9	81.3	79.4	78.0			
360.0	222.3	111.5	96.5	89.4	85.2	82.4	80.4	78.9			
380.0	231.6	114.0	98.4	90.9	86.5	83.5	81.3	79.7			
400.0	240.5	116.4	100.2	92.4	87.7	84.5	82.2	80.5			
420.0	249.1	118.7	101.9	93.8	88.9	85.5	83.1	81.3			
440.0	257.4	121.0	103.6	95.1	90.0	86.6	84.0	82.1			
460.0	265.4	123.1	105.2	96.5	91.2	87.5	84.9	82.9			

		DEWPOINT TEMPERATURE = R = 55.0 AIR TEMPERATURE = T = 105.0									
Q <sub>e</sub>	W=0	W=5	W=10	W=15	W=20	W=25	W=30	W=35			
80.0	8.5	55.7	62.8	65.5	67.0	67.8	68.4	68.8			
100.0	35.3	62.2	66.3	67.9	68.7	69.3	69.6	69.9			
120.0	58.5	68.1	69.5	70.1	70.4	70.6	70.8	70.9			
140.0	78.8	73.4	72.6	72.3	72.1	72.0	71.9	71.9			
160.0	97.1	78.4	75.5	74.4	73.7	73.3	73.0	72.8			
180.0	113.8	82.9	78.3	76.4	75.3	74.6	74.1	73.8			
200.0	129.1	87.1	80.9	78.3	76.8	75.8	75.2	74.7			
220.0	143.3	91.0	83.4	80.1	78.3	77.1	76.2	75.6			
240.0	156.5	94.7	85.8	81.9	79.7	78.3	77.2	76.5			
260.0	169.0	98.1	88.1	83.6	81.1	79.4	78.2	77.4			
280.0	180.8	101.4	90.3	85.3	82.4	80.6	79.2	78.2			
300.0	191.9	104.4	92.4	86.9	83.8	81.7	80.2	79.1			
320.0	202.5	107.3	94.4	88.5	85.0	82.8	81.1	79.9			
340.0	212.6	110.0	96.4	90.0	86.3	83.8	82.1	80.7			
360.0	222.3	112.6	98.2	91.5	87.5	84.9	83.0	81.6			
380.0	231.6	115.1	100.0	92.9	88.7	85.9	83.9	82.4			
400.0	240.5	117.5	101.8	94.3	89.9	86.9	84.7	83.1			
420.0	249.1	119.8	103.5	95.7	91.0	87.9	85.6	83.9			
440.0	257.4	122.0	105.1	97.0	92.1	88.8	86.5	84.7			
460.0	265.4	124.1	106.7	98.3	93.2	89.8	87.3	85.4			

# Appendix A

## TEMPERATURE DEPENDENCE OF RELATIVE ISOBARIC SLOPES

To include relative isobaric slopes in the vertically averaged momentum equations, replace the terms  $\frac{\partial \xi}{\partial x}$ , and  $\frac{\partial \xi}{\partial y}$  by the expanded terms  $g(\partial \xi / \partial x + \langle i_{x,p,\xi} \rangle_h)$  and  $g(\partial \xi / \partial y + \langle i_{y,p,\xi} \rangle_h)$  respectively. Pritchard gives the following expression for the vertically averaged isobaric slope: <sup>(19)</sup>

$$\langle i_{x,p,\xi} \rangle_h = 1/2 H \frac{1}{\rho} \frac{\partial \rho}{\partial x} = \frac{H}{2\rho} \frac{\partial \rho}{\partial s} \frac{\partial s}{\partial x} \quad (A1)$$

where  $\rho$  = vertically averaged density, and  $s$  = vertically averaged salinity. In terms of the specific volume defined by  $\alpha = 1/\rho$ , this becomes

$$i_h = (H/2) (\partial s / \partial x) \left( -\frac{1}{\alpha} \frac{\partial \alpha}{\partial s} \right) . \quad (A2)$$

The quantity  $\left( -\frac{1}{\alpha} \frac{\partial \alpha}{\partial s} \right)$  is the coefficient of saline contraction and may be obtained according to Eckart from the Tumlirz equation of state given by <sup>(20)</sup>

$$(p + p_o) (\alpha - \alpha_o) = \lambda \quad (A3)$$

where  $T$  is in °C and

$$\lambda = 1779.5 + 11.25T - .0745T^2 - (3.80 + .01T)s ,$$

$$\alpha_o = .6980 ,$$

$$p_o = 5890 + 38T - .375 T^2 + 3s ,$$

$$P = \text{total pressure (in atmospheres)} ,$$

$$\alpha = \text{specific volume in ml/gm} .$$

For  $H < 100$  m we can ignore  $p$  compared to  $p_o$ . For example, at 10 meters depth,  $p/p_o$  is less than  $10^{-3}$ . Since the empirical formula is accurate only to about 1%, our approximation is well justified. Evaluation of the saline contraction is now straightforward and the result is:

$$i_{x,h} = \frac{3.8 + .01T + 3 (\lambda/p_o)}{\lambda + \alpha_o p_o} (H/2) (\partial s / \partial x) . \quad (A4)$$

A similar result applies for x replaced by y.

If data is given in terms of chlorinity, one must use the following equation relating salinity and chlorinity (both in parts per thousand):<sup>(17)</sup>

$$s = .03 + 1.8050 Cl . \quad (A5)$$

Chlorinity is defined as the chlorine equivalent in parts per thousand of all precipitated halides. Equation (A5) does not apply to estuaries whose constituents are altered by significant fresh water flow.

Let  $s'$  and  $Cl'$  denote the salinity and chlorinity, respectively, expressed in g/liter sea water. Then

$$\begin{aligned} s' &= \rho s , \\ Cl' &= \rho Cl , \end{aligned} \quad (A6)$$

and

$$\begin{aligned} s' &= .03\rho + 1.805 Cl' \\ &= \frac{.03}{\alpha_o + \lambda/p_o} + 1.805 Cl' \end{aligned} \quad (A7)$$

In terms of  $s'$ ,  $i_{x,h}$  becomes

$$i_{x,h} = (H/2) (\partial s' / \partial x) \left( - \frac{1}{\alpha} \frac{\partial \alpha}{\partial s'} \right) . \quad (A8)$$

We also obtain

$$- \frac{1}{\alpha} \frac{\partial \alpha}{\partial s'} = \frac{-1}{\alpha (\partial s' / \partial \alpha)} = \frac{-1}{\frac{\partial s}{\partial \alpha} - \frac{s}{\alpha}} = \frac{1}{\frac{\partial s}{\partial \alpha} + s'} \quad (A9)$$

and

$$\partial s' / \partial x = .03(\partial \rho / \partial x) + 1.805(\partial Cl' / \partial x) . \quad (A10a)$$

In (A10a) the first term on the right hand side is roughly  $10^5$  times smaller than the second term, so we can write approximately

$$\partial s' / \partial x = 1.805 (\partial C1' / \partial x) \quad (A10b)$$

In terms of chlorinity, the isobaric slope is given by

$$i_{x,h} = 1.805(H/2) \left\{ (\partial C1' / \partial x) / \left[ 1.805 C1' + \frac{.03}{\frac{\lambda}{p_o} + \alpha_o} + \frac{p_o}{3.8 + .01T + \frac{3\lambda}{p_o}} \right] \right\} \quad (A11)$$

where  $s$  appearing in the definitions of  $\lambda$  and  $p_o$  is given by

$$s = .03 + 1.805 \frac{C1'}{1.02} = .03 + 1.770 C1' \quad (A12)$$

In (A12) we have used the value  $\rho = 1.02$ , which is correct within 1% for the range of temperature and salinity under consideration. Errors of order 1% in  $s$  will produce errors of order only .001% in  $\lambda$  and  $p_o$ . Similar arguments lead us to drop the term  $.03(\alpha_o + \lambda/p_o)^{-1}$  in (A11).

Temperature gradients will also contribute to the relative isobaric slope. For example, (A1) is modified according to

$$i_{x,h} = (H/2) \left( \frac{1}{\rho} \frac{\partial \rho}{\partial s} \frac{\partial s}{\partial x} + \frac{1}{\rho} \frac{\partial \rho}{\partial T} \frac{\partial T}{\partial x} \right). \quad (A13)$$

The coefficient of thermal expansion is not given as accurately by our equation of state as is the saline contraction. However, this is compensated by the smaller magnitude of the former effect.

From (A3) we find

$$\begin{aligned} \frac{1}{\rho} \frac{\partial \rho}{\partial T} &= - \frac{1}{\alpha} \frac{\partial \alpha}{\partial T} = - \frac{1}{\alpha} \left[ \frac{\partial}{\partial T} (\lambda/p_o) \right] \\ &= \frac{(\lambda/p_o) (\partial p_o / \partial T) - (\partial \lambda / \partial T)}{\lambda + \alpha_o p_o} \\ &= \frac{(\lambda/p_o) (38 - .750T) - (11.25 - .149T - .018 C1')}{\lambda + \alpha_o p_o} \end{aligned} \quad (A14)$$

Finally, the relative isobaric slope as a function of chlorinity (in g/liter), temperature ( $^{\circ}\text{C}$ ), the corresponding gradients, and depth is given by

$$i_{x,h} = (H/2) \left[ \frac{1}{\rho} \frac{\partial \rho}{\partial Cl'} \frac{\partial Cl'}{\partial x} + \frac{1}{\rho} \frac{\partial \rho}{\partial T} \frac{\partial T}{\partial x} \right] \quad (A15)$$

$$= 1.805(H/2) \frac{\partial Cl'/\partial x}{1.805Cl' + \frac{p_o}{3.8 + .01T + (3\lambda/p_o)}} \quad (A16)$$

$$+ (H/2) (\partial T/\partial x) \cdot$$

$$\frac{(\lambda/p_o)(38 - .750T) - (11.25 - .149T - .918 Cl')}{\lambda + \alpha_o p_o}$$

where  $\lambda$ ,  $p_o$ , and  $\alpha_o$  are defined in (A3) and the value of  $s$  used to evaluate  $\lambda$  and  $p_o$  is given by (A12)

Equation (A16) may be used for machine computation when large salinity or temperature gradients make it desirable to employ local values of the saline contraction or thermal expansion coefficient. In most cases it will be better to use averaged values for the coefficients over the entire field. Typical numerical results for thermal and chlorinity coefficients are  $2 \times 10^{-4}$  and  $1.3 \times 10^{-3}$  respectively.

Table A

Table of  $Z(T,C)$  where  $Z$  is the coefficient of chlorinity contraction as a function of centigrade temperature and chlorinity in grams per liter.

Chlorinity in g/l	T=10	T=15	T=20	T=25	T=30
10.000	1.350-03	1.335-03	1.324-03	1.317-03	1.315-03
10.250	1.349-03	1.334-03	1.323-03	1.317-03	1.314-03
10.500	1.348-03	1.333-03	1.322-03	1.316-03	1.313-03
10.750	1.347-03	1.332-03	1.321-03	1.315-03	1.312-03
11.000	1.346-03	1.331-03	1.320-03	1.314-03	1.311-03
11.250	1.345-03	1.330-03	1.319-03	1.313-03	1.310-03
11.500	1.344-03	1.329-03	1.318-03	1.312-03	1.309-03
11.750	1.343-03	1.328-03	1.317-03	1.311-03	1.308-03
12.000	1.342-03	1.327-03	1.316-03	1.310-03	1.307-03
12.250	1.341-03	1.326-03	1.315-03	1.309-03	1.306-03
12.500	1.340-03	1.325-03	1.314-03	1.308-03	1.305-03
12.750	1.339-03	1.324-03	1.313-03	1.307-03	1.305-03
13.000	1.338-03	1.323-03	1.313-03	1.306-03	1.304-03
13.250	1.337-03	1.322-03	1.312-03	1.305-03	1.303-03
13.500	1.336-03	1.321-03	1.311-03	1.304-03	1.302-03
13.750	1.335-03	1.320-03	1.310-03	1.303-03	1.301-03
14.000	1.334-03	1.319-03	1.309-03	1.302-03	1.300-03
14.250	1.333-03	1.318-03	1.308-03	1.301-03	1.299-03
14.500	1.332-03	1.317-03	1.307-03	1.301-03	1.298-03
14.750	1.331-03	1.316-03	1.306-03	1.300-03	1.297-03
15.000	1.330-03	1.315-03	1.305-03	1.299-03	1.296-03
15.250	1.329-03	1.314-03	1.304-03	1.298-03	1.295-03
15.500	1.328-03	1.313-03	1.303-03	1.297-03	1.294-03
15.750	1.327-03	1.312-03	1.302-03	1.296-03	1.294-03
16.000	1.326-03	1.312-03	1.301-03	1.295-03	1.293-03
16.250	1.325-03	1.311-03	1.300-03	1.294-03	1.292-03
16.500	1.324-03	1.310-03	1.299-03	1.293-03	1.291-03
16.750	1.323-03	1.309-03	1.298-03	1.292-03	1.290-03
17.000	1.322-03	1.308-03	1.297-03	1.291-03	1.289-03
17.250	1.321-03	1.307-03	1.297-03	1.290-03	1.288-03
17.500	1.320-03	1.306-03	1.296-03	1.289-03	1.287-03
17.750	1.319-03	1.305-03	1.295-03	1.289-03	1.286-03
18.000	1.318-03	1.304-03	1.294-03	1.288-03	1.285-03
18.250	1.317-03	1.303-03	1.293-03	1.287-03	1.284-03
18.500	1.316-03	1.302-03	1.292-03	1.286-03	1.284-03
18.750	1.315-03	1.301-03	1.291-03	1.285-03	1.283-03
19.000	1.315-03	1.300-03	1.290-03	1.284-03	1.282-03
19.250	1.314-03	1.299-03	1.289-03	1.283-03	1.281-03
19.500	1.313-03	1.298-03	1.288-03	1.282-03	1.280-03
19.750	1.312-03	1.297-03	1.287-03	1.281-03	1.279-03
20.000	1.311-03	1.296-03	1.286-03	1.280-03	1.278-03

## Appendix B

### MODIFIED DEWPOINT TEMPERATURE

Rather than regard  $T_{eq}$  as a function of  $Q$  = absorbed radiation,  $W$ ,  $T_a$  and  $T_d$  we can take advantage of the following procedure which considerably simplifies interpolation in the tables. The air temperature and dewpoint temperature enter the equation for  $T_{eq}$  only in the term  $(e_{eq} - e_a + BT_{eq} - BT_a)$  where, as before,  $e_a = e(T_d)$ . Let us define a "modified dewpoint temperature,"<sup>(21)</sup>  $J$ , according to

$$e_{eq} - e_a + B(T_{eq} - T_a) = e_{eq} - e(J) + B(T_{eq} - J) \quad (B1)$$

or,

$$e(J) = BJ = e_a + BT_a \quad (B2)$$

The modified dewpoint  $J$  may be found by Newton's method and tabulated as a function of  $T_a$  and  $T_d$ . The equilibrium temperature may then be found as a function of  $J$ ,  $W$  and  $Q$ . In particular,

$$T_{eq}(T_a, T_d, W, Q) = T_{eq}(J, J, W, Q) \quad (B3)$$

so that we need only the first section (where  $V = 0$  and  $T = R$ ) of Table 3.

$J$  is tabulated in Table B as a function of  $T_a$  and  $V = T_a - T_d$ .

Table B

Table of modified dewpoint temperature  $J(T,R)$  as a function of air temperature  $T$  and  $V = [\text{air temperature} - \text{dewpoint temperature}]$ , all in degrees Fahrenheit.

T=	V=0	V=5	V=10	V=15	V=20	V=25	V=30	V=40	V=50	V=60
0.	.0	-.8	-1.4	-1.9	-2.3	-2.6	-2.8	-3.2	-3.4	-3.5
5.	5.1	4.2	3.4	2.8	2.3	1.9	1.6	1.2	.9	.8
10.	10.1	9.0	8.1	7.4	6.8	6.3	5.9	5.4	5.1	4.9
15.	15.1	13.9	12.8	11.9	11.2	10.7	10.2	9.5	9.1	8.9
20.	20.1	18.7	17.5	16.5	15.6	14.9	14.4	13.6	13.1	12.8
25.	25.1	23.5	22.1	20.9	20.0	19.2	18.5	17.5	16.9	16.6
30.	30.2	28.3	26.7	25.4	24.2	23.3	22.6	21.4	20.7	20.2
35.	35.2	33.1	31.3	29.8	28.5	27.4	26.5	25.2	24.3	23.8
40.	40.2	37.9	35.9	34.2	32.7	31.5	30.5	28.9	27.9	27.2
45.	45.2	42.7	40.5	38.6	37.0	35.6	34.4	32.6	31.4	30.6
50.	50.0	47.5	45.1	43.0	41.2	39.6	38.3	36.2	34.8	33.8
55.	55.0	52.3	49.7	47.4	45.4	43.6	42.1	39.8	38.1	37.0
60.	60.0	56.9	54.3	51.8	49.6	47.7	46.0	43.3	41.4	40.1
65.	65.0	61.7	58.8	56.3	53.9	51.7	49.9	46.9	44.7	43.2
70.	70.0	66.6	63.4	60.6	58.1	55.8	53.8	50.4	48.0	46.2
75.	75.0	71.4	68.1	65.0	62.3	59.9	57.7	54.0	51.3	49.3
80.	80.0	76.3	72.8	69.6	66.6	63.9	61.7	57.6	54.5	52.3
85.	85.0	81.1	77.5	74.1	71.0	68.1	65.5	61.3	57.9	55.3
90.	90.0	86.0	82.3	78.7	75.4	72.4	69.6	65.0	61.2	58.3
95.	95.0	90.9	87.0	83.4	79.9	76.7	73.7	68.8	64.6	61.4
100.	100.0	95.8	91.8	88.0	84.4	81.1	77.9	72.4	68.1	64.5
105.	105.0	100.7	96.6	92.7	89.0	85.5	82.2	76.3	71.6	67.7
110.	110.0	105.7	101.5	97.4	93.6	89.9	86.5	80.3	75.1	71.0

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